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THE PETROLEUM ENGINEER PUBLISHING COMPANY

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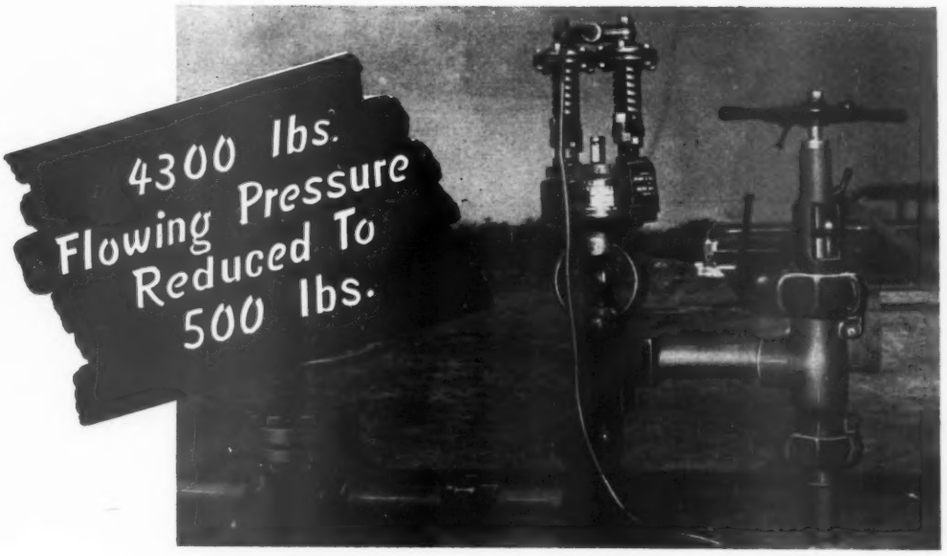

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The Course of Oil

by K. C. SCLATER

FOREIGN TRADE BARRIERS

A brief but highly pertinent discussion of cartels as they relate to American oil companies operating in foreign countries prepared by A. Jacobsen, New York, in his summary of testimony presented at hearings before the special Committee investigating petroleum resources, outlines the anomalous position in which American oil companies engaged in foreign operations may find themselves unless cartels —artificial interference with free competition—are abolished.

Here is a digest of the discussion as presented by Jacobsen: The term "cartel" is used very loosely and without any clear definition, but we may perhaps take it to mean any artificial or strong-arm interference with free competition, whether enforced or sponsored by government or private interests. Such restrictive measures are exceedingly common and are enforced in numerous foreign countries. They take a great many different forms. The reasons these countries give for enforcing or encouraging these restrictive measures are many, among them the desire to conserve foreign exchange, the promotion of national defense, the increase of employment, the augmentation of internal revenue, the protection of domestic enterprises, or just the general totalitarian idea that the government should control all important business.

The American oil industry does not want these restrictive measures or cartels. They do not want them for the good and legitimately selfish reason that they can do better without them. The American oil industry has amply proved its ability to compete in the world market and more than hold its own. In countries that enforce cartels, however, it is not a question of what the American oil industry would like, but of the conditions they have to face. The solution the American companies would prefer would be to see such countries persuaded by our State Department to open up their oil markets to free competition. If this solution is not feasible, the companies will in many countries have only two courses open to them: (a) conform to the particular type of restrictive regulation or cartel in force in a given country, or (b) retire from business in such country.

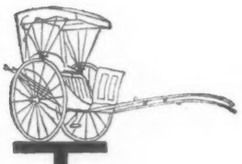
In the last analysis it will be for Congress to say what our national policy should be in this respect. A decision in this regard will affect not only the oil industry, but most other American industries engaged in foreign trade. If the decision be that American companies must not engage in business in such countries, we shall actually play into the hands of our foreign competitors and shall, to some extent at least, be placing a premium on the establishment of cartels abroad. We shall be providing our foreign competitors with an unfailing method of ridding themselves of troublesome American competition. If it becomes known that the imposition of any regulations that can be considered as cartels will mean the immediate and automatic elimination of American competition, we must expect our foreign competitors to use their best endeavors to convince the powers that be in the foreign country of the advantages of establishing a cartel.

Such abandonment of our long established foreign trade would not only have a bad effect on our domestic economy, but would adversely affect our national security. The war just ended has proved the great value to our armed forces of oil installations constructed by the American petroleum industry in many parts of the world and of an organization of American citizens thoroughly acquainted with foreign conditions.

Keeping in mind that a decision on the question of abandoning American operations abroad will not only affect the oil industry, but practically all other American industries engaged in foreign trade, it is evident that the decision will have a direct bearing on the important question of American employment and trade.

If the decision be that, much as we dislike all measures restrictive of free competition, and anxious as we are to see them abolished wherever we can bring our influence to bear to that end, it is contrary to our national interests to abandon all our foreign operations in countries where such operations are subject to cartel arrangements, then we should agree that American companies should be clearly allowed to operate abroad under such conditions without any fear of prosecution under our antitrust laws.

Considerable discussion on that subject took place before this Committee, during which it was brought out that to date no prosecution of any American company has taken place based on operations abroad under conditions such as those here mentioned. At the same time, however, widely different views are expressed by responsible government representatives with regard to the liabilities assumed under our antitrust laws by companies operating abroad, and I trust this Committee will agree that American companies in their foreign operations are entitled to definite assurance that they will be free from any threat of prosecution under our antitrust laws in operating abroad in accordance with the laws and established customs of the countries in which they operate.



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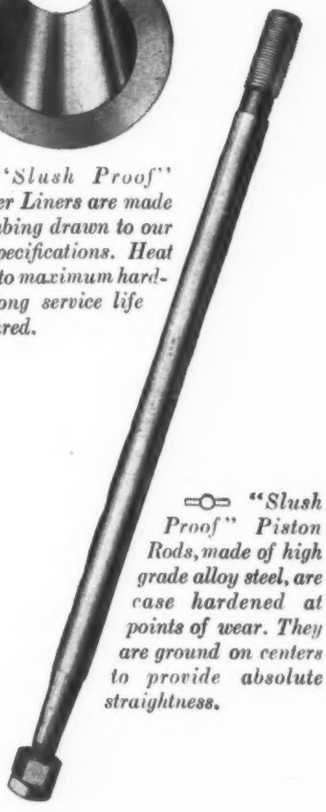

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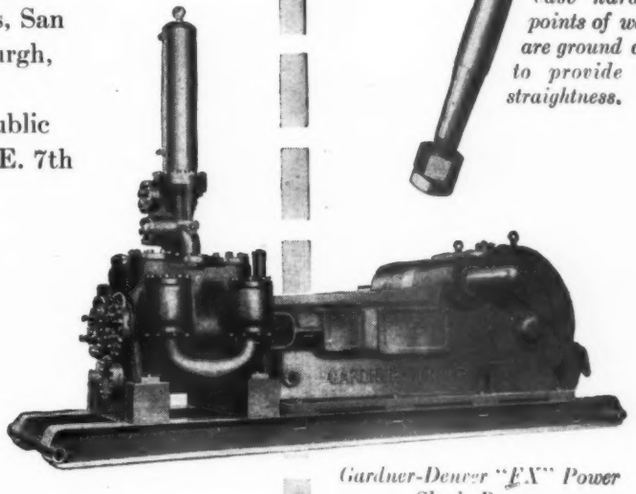

Gardner-Denver "FX" Power Slush Pump.

Scanning WASHINGTON'S OIL HORIZON

By MILBURN PETTY

WASHINGTON—Question of whether military or civilian authorities will have charge of developing a national oil policy is heading for a showdown at the White House. Some industry leaders, who had sided with the military in preference to Mr. Ickes with his alleged ambitions for federal oil control, are taking another look at the situation now that the Ole Curmudgeon has stepped down from the Interior Department.

Also, these oil men have been worried recently by the military's suggestions that wartime oil controls be restored to assure the Navy of an adequate fuel oil supply. Oil men blamed OPA, promising plenty of oil if price controls were removed. The Navy was inclined to agree, but was conscious of its responsibilities.

With the April-June quarter started, the Navy was still more than 100,000 bbl. per day short of contractual commitments to meet its requirements of 270,000 bbl. a day of fuel oil. Some ship sailings had been delayed for lack of oil. Twice in a single week the Navy's fuel oil storage tanks at New York Harbor had run dry. Fuel oil price ceilings had been increased by OPA but with little increase in supply to the Navy. (If subsequent easing of oil price controls improves the situation, the industry can be thankful that it has got by some thin ice in its public relations.) So, military authorities have been urging that some supply-distribution controls, possibly some refining directives, too, be restored—so far without success.

That is the background against which a decision will be made at the White House as to control over development of a national oil policy. At this point, a compromise of the military vs. civilian issue seems likely. Most probable outcome will be an interdepartmental oil board with the Secretary of Interior as chairman. Besides coordinating all governmental oil activities, such a board also would be charged with formulating a policy to assure an adequate oil supply—in this country and accessible foreign areas—for any national emergency.

An executive order setting up such a board, composed of the secretaries of Interior, War, Navy, State, and Commerce, has already been drafted for early submission to President Truman. It also provides for an industry advisory committee.

Preliminary discussions have been about a 25-member advisory group; however, this is likely to draw fire from the industry. It would be hard to pick and choose among the 22 major companies, yet if all of them were given representation there wouldn't be room for the independents. So, there is bound to be demands for a larger group. Subcommittees probably would be established on such matters as secondary recovery, exports and imports, synthetic fuels, military products, etc. A tie-in with state oil regulatory agencies might also be established.

Such a set-up, providing a central point of contact for the industry's relations with government agencies, and vice versa, would eliminate much of the confusion now existing.

Meanwhile, Interior Department is going ahead with its proposals—under the governmental reorganization program—for centralizing in Interior all the non-regulatory activities on oil and gas now handled by other agencies and departments. Undoubtedly, Interior would like to be the operating arm of the 5-department oil board.

The military's program for a permanent oil set-up, built around the Army-Navy Petroleum Board with an industry advisory committee, is now at the White House for approval.

So, the issue of who is to dominate in oil policies soon will be sharply drawn.

● **BIG INCH.** The odds now favor oil use of at least one of the Big Inch pipe lines. Several combination offers (one line for gas, the other for oil) have become firmer. Major oil companies still profess lack of interest in oil use. It is unlikely, however, that they will stand idly by and see the lines fall into non-industry hands for oil use. At least one major oil company group has contacted War Assets Administration regarding an oil-use proposition the group is working on.

● **CONTINENTAL SHELF.** Interior Department has completed its draft of a 10-year program for oil and gas exploration of the Continental Shelf. As a starter, $5,000,000 will be sought from Congress for work—probably along the Gulf Coast—during the fiscal year beginning July 1. Interior proposes to build a million-dollar laboratory to develop and test new devices for undersea exploration. The airborne magnetometer is expected to play a big part in these surveys.

● **CO-OPS.** As this is an election year, any move to curtail the tax exemptions of cooperatives is unlikely to get anywhere in Congress. Meanwhile, the co-ops have struck back at oil industry criticism by filing with Senator O'Mahoney's oil committee a statement attacking the oil and gas depletion allowance as a "subsidy," which, they assert, deprives the government of many millions more than represented by co-op tax exemptions.

● **STRIPPER WELLS.** Removal of oil price controls will mean an end to the present stripper well subsidy, which has paid premiums ranging up to 75 cents per bbl. on Pennsylvania Grade crude; but talk has been resumed about some kind of permanent subsidy. At the O'Mahoney oil hearings stripper well operators from all over the country broke away from the general presentation by independent producers and backed a federal subsidy. They expressed their dislike for a subsidy but said they felt that crude price postings would never be high enough to support secondary recovery. Their attitude was that the government should be sufficiently interested in preserving the stripper well reserves to undertake a subsidy program as a conservation measure.

● **PUBLIC LANDS.** Hearings probably will be held in May on pending bills to amend the public lands oil and gas leasing law. Proposals for a flat 12½ per cent royalty have been renewed by Senators O'Mahoney, Wyoming, and Hatch, New Mexico. This came after Interior Department had filed its report on Senate Bill 1236 taking issue with it on many points. Interior is willing to have Congress authorize the Interior Secretary to up limitations on a single operator's holdings in one state from 7,680 to 20,000 acres, provided that it is left to the Secretary's discretion. Also, Interior is very much opposed to suggestions that the government be required to take its royalty oil in kind if not satisfied with the posted field price.

● **TIDELANDS.** Although a majority of the senators probably favor the Sumners-McCarran Resolution declaring state ownership of submerged lands, the measure still may not come up for a vote at this session. Senate leaders fear a presidential veto if the resolution is passed before the Supreme Court rules in the federal government's suit challenging California's title to offshore lands. The people back home may become aware of the situation in time to force the issue, however.

● **OIL TREATY.** It seems a safe bet now that the Anglo-American Oil Agreement will not come up for hearings until next fall before the Senate Foreign Relations Committee. State Department appears unwilling to join up with Deputy PAW Administrator Davies to put the heat on Chairman Tom Connally (Texas) for hearings before the summer recess. And Davies is adamant on leaving government service April 30, even if PAW should be continued beyond that date.

● **OIL FORECASTS.** To provide for better coordination of governmental information on future requirements of petroleum products, Interior Department has established "Interdepartmental Committee on Petroleum Requirements" under the chairmanship of the Bureau of Mines. Idea is that requirements for export, military, shipping, and other needs have become so great that even a slight miscalculation could throw the Bureau's forecasts way off (as happened with the crude demand forecast for March). Agencies represented include State Department, Federal Power Commission, Army, Navy, War Shipping Administration, Office of War Mobilization and Reconversion, Agriculture Department, and Interstate Commerce Commission.

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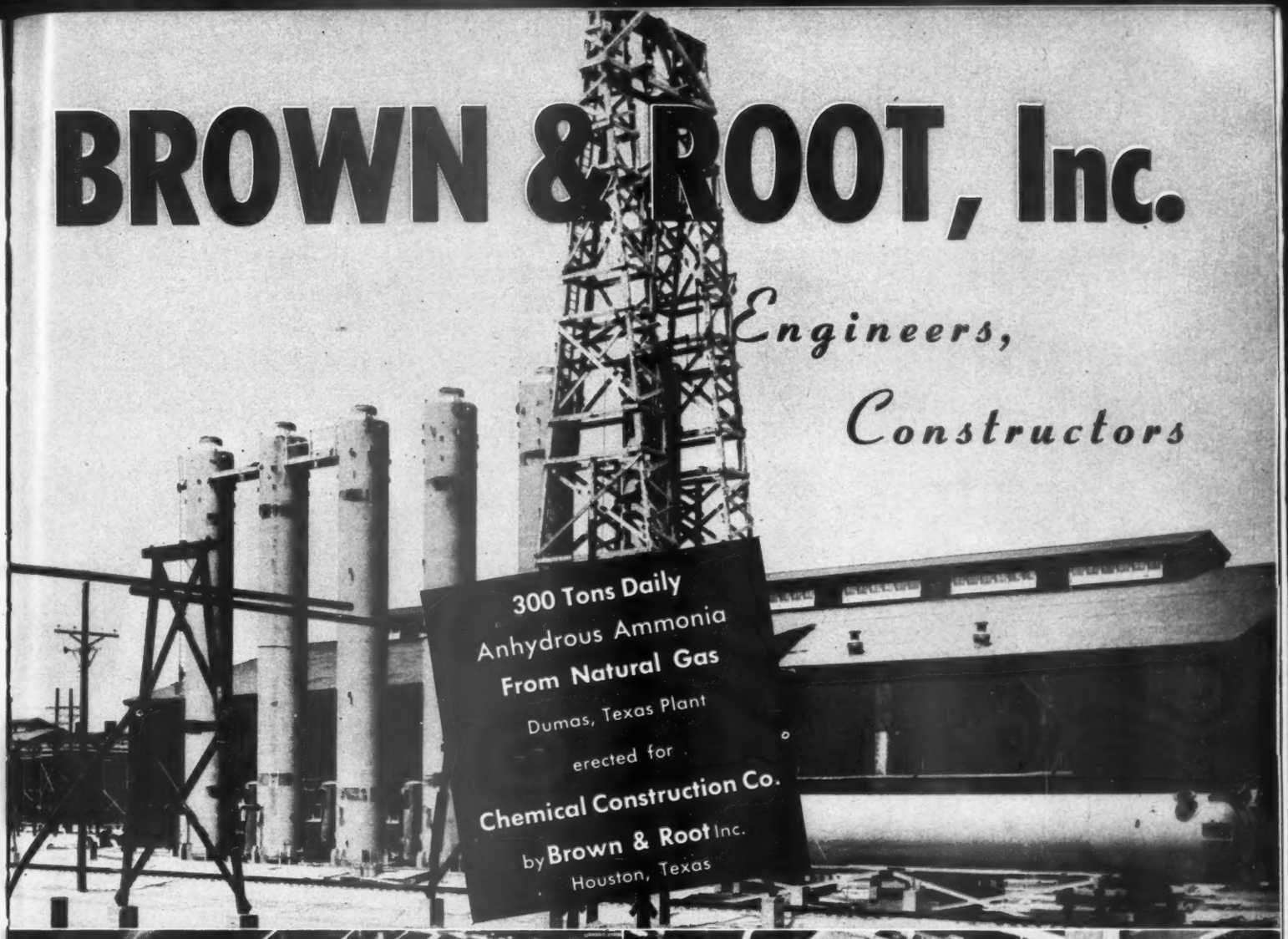

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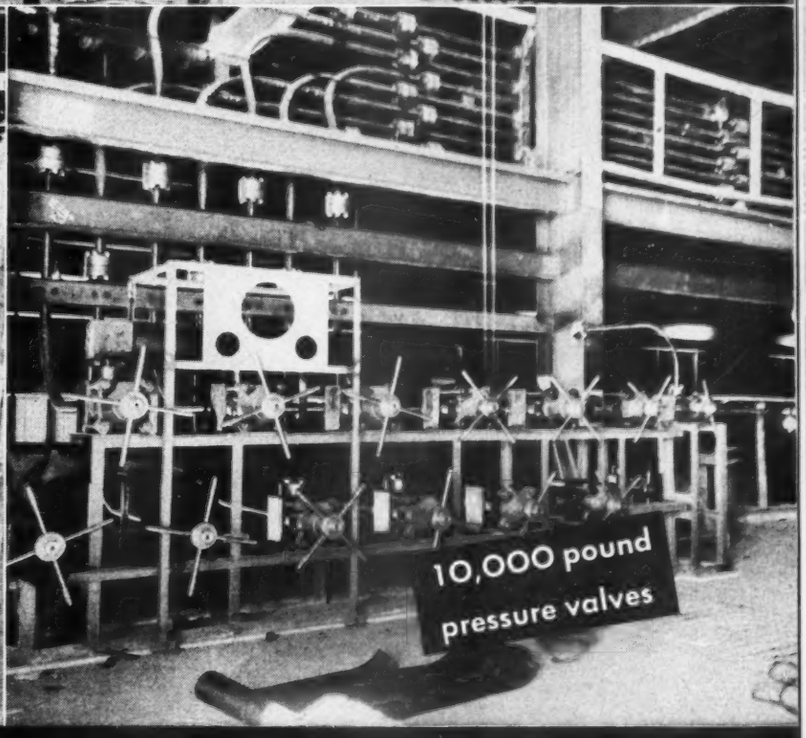

10,000 pound
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NATIONAL PETROLEUM SITUATION

SUPPLY EXCEEDS DEMAND. Preliminary figures for 1st quarter of 1946 show marked change in supply and demand of petroleum industry. Crude oil supply exceeded demand by 9,600,000 bbl., a monthly average surplus of 3,200,000 bbl. In last 5 years there was a shortage of 1,056,000 bbl. monthly. Supply of all oils in 1st quarter exceeded demand by 4,029,000 bbl., a monthly average surplus of 1,343,000 bbl. In the last 5 years there was a shortage of all oils of 1,691,000 bbl. monthly.

DRILLING UP TWELVE PER CENT. Total well completions in 1st quarter exceeded last year by 12 per cent. Completions were 6640 against 5938 last year. Development drilling exceeded quota by 3 per cent, but wildcat operations were about 24 per cent below normal.

RISING TREND OF IMPORTS. Imports of crude oil and refined products continue to attain new heights. Crude imports in first quarter amounted to about 22,673,000 bbl., which would be at an annual rate of over 90,000,000 bbl. This compares with 74,000,000 in 1945; 45,000,000 in 1944; 14,000,000 in 1943 and 12,000,000 in 1942. Imports of all oils are now at annual rate of 134,000,000 bbl., against 113,000,000 in 1945; 92,000,000 in 1944; 63,000,000 in 1943 and 36,000,000 in 1942.

STOCKS UP 10,000,000 BBL. Stocks of crude and refined products have shown an increase over a year ago of 10,643,000 bbl. With the exception of fuel oil, stocks are more than adequate for immediate requirements. While motor fuel stocks are 13 per cent above last year, fuel oil stocks are 1 per cent below a year ago. The inadequacy of fuel stocks is shown by only 27 days' supply, whereas motor fuel storage represents 52 days supply at current requirements. Combined stocks are about 6 per cent sub-normal.

CRUDE OUTPUT EXCESSIVE. While some contend that crude production schedules are too low and others say they are too high, the fact remains that the rate in the first quarter of this year was about 100,000 bbl. in excess of actual requirements. Factors contributing to the excess are a 10 per cent drop in motor fuel demand under last year and a 21 per cent increase in crude oil imports.

REFINING OPERATIONS NORMAL. While refinery runs to stills in the first quarter of this year were about 150,000 bbl. below last year's daily average, the refining situation shows a balanced condition. Efforts to meet the fuel oil shortage and to reduce motor fuel output are shown by the reduction in gasoline yields from 40.9 per cent last year to 38.2 per cent in the first quarter of this year.

Comparative Statistics, March, 1946

*All figures are computed on a Bureau of Mines' Basis**

	Mar.(p)¶ 1946	Feb (p) 1946	March 1945	This year to date	Last year to date	Per cent change
Wells drilling	3,610	¶3,750	3,950	3,610	3,950	— 9
Total wells drilled	2,329	1,954	2,028	6,640	5,938	+12
Development wells	1,977	1,710	1,729	5,699	4,979	+14
Oil	1,217	1,077	1,078	3,558	3,077	+16
Gas	217	199	174	617	532	+16
Dry	543	434	477	1,524	1,370	+11
Per cent dry	27.5	25.4	27.6	26.7	27.5	— 0.8
Wildcat wells	352	244	299	941	959	— 2
Oil	57	42	62	134	159	—11
Gas	7	9	11	25	34	—26
Dry	288	193	236	782	775	+ 1
Per cent dry	81.8	79.1	73.6	83.1	80.8	+ 2.3
Crude production	136,900	133,960	148,758	414,360	429,182	— 3
Daily average	4,416	4,749	4,799	4,604	4,769	
Crude demand	148,350	132,475	147,948	427,425	431,424	— 1
Daily average	4,785	4,731	4,773	4,749	4,794	
Crude stocks	228,400	231,750	229,555	228,400	229,555	— 1
Days supply	48	49	48	48	48	
Natural gasoline production	8,950	8,030	9,523	26,005	27,879	— 7
Daily average	289	287	307	289	310	
Motor fuel production	61,700	54,430	67,955	178,370	198,120	—10
Daily average	1,990	1,944	2,192	1,982	2,201	
Gasoline yield, per cent	38.2	38.5	40.8	38.2	40.9	— 2.7
Motor fuel demand	60,350	52,455	67,858	168,120	186,347	
Daily average	1,947	1,873	2,189	1,868	2,071	—10
Motor fuel stocks	101,650	100,300	90,298	101,650	90,298	+13
Days supply	52	54	41	52	41	
Fuel oil production	64,060	57,200	60,405	183,625	180,231	+ 2
Daily average	2,066	2,043	1,949	2,040	2,003	
Fuel oil demand	69,410	65,418	73,826	213,753	229,472	— 7
Daily average	2,239	2,336	2,381	2,375	2,556	
Fuel oil stocks	61,550	62,500	62,180	61,550	62,180	— 1
Days supply	27	27	26	27	26	
Refinery still runs	143,200	127,900	146,285	412,450	426,238	— 3
Daily average	4,619	4,568	4,719	4,583	4,736	
All refined stocks	235,008	240,950	223,290	235,008	223,290	+ 5
Days supply	46	47	40	46	40	

*Unless otherwise stated all figures represent thousands of barrels.
¶Revised.

Economic Position of U. S. Petroleum Industry

Three Months Ending March 31, 1946

	Normal	Actual	Per cent of normal
Drilling*** (wells completed)	6,750	6,640	98
Production (daily crude output)	4,497	4,604	102
Refining (daily still runs)	4,594	4,583	100
Stocks (crude and refined)	494,550	463,408	94
Price of crude (per bbl.)	$2.04	$1.33	65

Crude Prices by States for March, 1946§

U. S. average	$1.33	Louisiana	$1.32
Texas	1.31	Arkansas	1.13
California	1.17	New Mexico	1.10
Oklahoma	1.29	Mississippi	1.20
Kansas	1.30	Illinois	1.47
		Other states	1.99

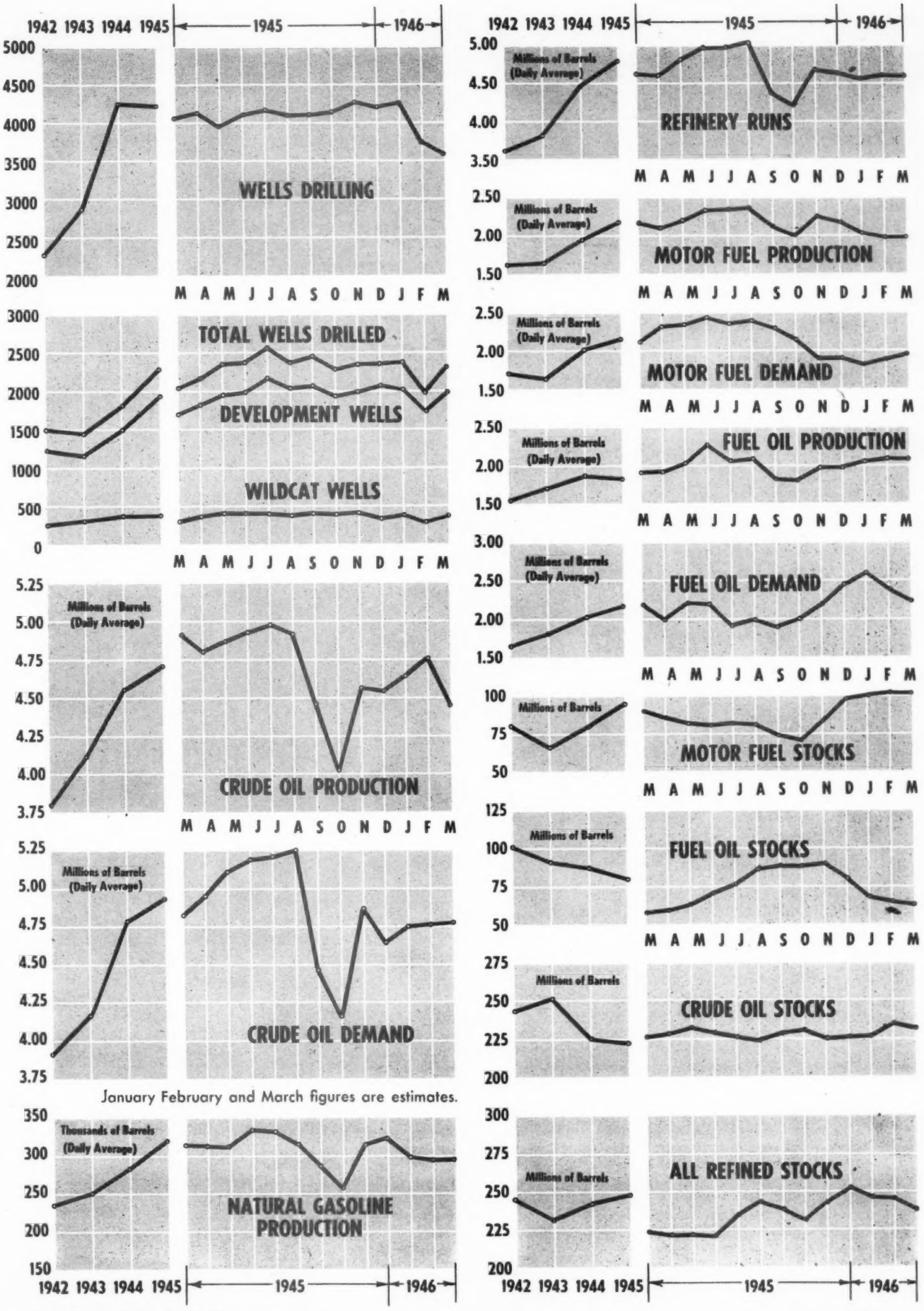
Basic crude prices

Oklahoma-Kansas (36 gr.)	$1.37
Texas Gulf Coast (36 gr.)	1.50
East Texas	1.35
West Texas (36 gr.)	1.14
Calif. Signal Hill (26 gr.)	1.21
Pennsylvania Bradford	3.10

Drilling and Production Statistics by States

	March 1946	Feb. 1946	March 1945	This year to date	Last year to date	Per cent change
Total wells drilled	2,329	1,954	2,028	6,640	5,938	+12
Texas	675	559	525	1,909	1,635	+17
California	162	124	200	442	580	—24
Oklahoma	200	183	171	595	543	+10
Kansas	159	137	144	487	358	+36
Louisiana	120	95	99	317	247	+28
Arkansas	10	19	3	40	27	+48
New Mexico	34	28	43	106	118	—10
Mississippi	24	14	27	61	75	—19
Illinois	173	135	105	486	384	+27
Other states	772	660	711	2,197	1,971	+11
Wildcats drilled	352	244	299	941	959	— 2
Texas	148	92	115	348	396	—12
California	26	14	19	64	55	+16
Oklahoma	38	28	39	120	99	+21
Kansas	18	16	20	65	81	—20
Louisiana	27	15	16	52	40	+30
Arkansas	2	5	1	8	12	—33
New Mexico	4	2	3	16	19	—16
Mississippi	12	5	15	22	33	—33
Illinois	26	24	20	91	70	+30
Other states	51	43	51	155	154	+ 1
Daily crude production	4,416	4,749	4,799	4,604	4,769	— 3
Texas	1,854	2,135	2,173	2,011	2,162	— 7
California	852	848	904	847	898	— 6
Oklahoma	362	392	370	384	366	+ 5
Kansas	244	253	273	249	269	— 7
Louisiana	371	368	355	369	352	+ 5
Arkansas	77	77	80	77	80	— 4
New Mexico	94	100	105	98	105	— 7
Mississippi	54	55	50	54	50	+ 8
Illinois	211	215	206	216	207	+ 4
Other states	297	306	283	299	280	+ 7

§Prices set by OPA. Prices do not include subsidies.
(p) Preliminary.
***Does not include input wells.



January February and March figures are estimates.

Highlights IN OILDOM

● **ASKS END OF PAW.** Acting Petroleum Administrator for War Ralph K. Davies has recommended to the Bureau of the Budget that the war oil agency be terminated April 30, and has asked that an executive order be issued accomplishing this final liquidation.

"The war job in oil is successfully completed," he said. "There remains only the task of closing house in an orderly manner, and this can all be finished between now and April 30. The termination order will thus make good our oft-repeated promise to discontinue this oil agency just as soon as its war purpose had been served."

President Roosevelt created the agency on May 28, 1941, as the Office of Petroleum Coordinator. Subsequently, the powers of the office were enlarged and the name changed to the Petroleum Administration for War. Secretary of the Interior Harold L. Ickes functioned as administrator and Ralph K. Davies as deputy administrator throughout the entire war period.

Secretary Ickes has since resigned from government service and Davies remains on to wind up the affairs of the agency.

● **PATMAN CALLS FOR DECONTROL OF OIL.** Congressman Wright Patman of Texas, chairman of the House Small Business Committee, has called on Paul Porter, head of OPA, to immediately lift price controls on crude oil and petroleum products. Patman, in his letter to the OPA Administrator, reiterates the views independent operators have expressed many times, that now that supply and demand are in balance in the oil industry there is no reason for further price control and that its continuation would only lead to increasing the depression into which the industry has been forced. Patman stated, "In my opinion, continuance of price control on crude oil can only serve to encourage the trend toward monopoly in crude petroleum production which became so apparent during war. That, I know, is something that your agency does not wish to encourage."

Patman called attention to former OPA Administrator Bowles' suggestion that the oil industry might be taken out from under price control, possibly prior to June 30, of this year, and urged Porter, personally, to authorize the immediate lifting of controls. "Crude oil prices," he stated, "have remained at a low level during the war because your agency has declined to give consideration to drilling, operating, and lifting costs of the small producers aside and apart from the costs of the major concerns, which enjoy the profitable sidelines of refining and marketing. Despite this fact these small producers have made a major contribution to the war effort with a minimum of recognition for their contribution.

"There is in existence Directive 68 of the Office of Economic Stabilization that authorizes your agency to decontrol prices on those products in which supply and demand have again reached a balance, and where such decontrol will not seriously affect the overall cost of living.

"If your agency is to attack aggressively the large volume of price adjustment applications in other product lines that I am informed now exist, it seems to me that you must release your pricing experts from work on the less critical items and utilize their services in the processing of applications from other industry groups where controls must be retained until the supply and demand picture is more in balance.

"To pursue a more aggressive policy of decontrol takes courage and sound judgment. I feel that the oil industry is the proper place to begin operations under such a policy of calculated control.

"The House Small Business Committee, of which I am chairman, has studied the oil price situation very carefully throughout the war from the viewpoint of the small producers. Our studies were made at the specific request of Speaker Sam Rayburn and other concerned members. I feel that the time has now come to give these small firms the relief from controls which they so definitely deserve."

● **DECRIES REDUCED AMOUNT LEAD ALLOCATED REFINERIES.** The nation faces a return to low-quality, wartime gasoline as a result of the ruling of the Civilian Production Administration reducing the amount of lead available to refiners for gasoline production, President William R. Boyd, Jr., of the American Petroleum Institute, has declared.

The ruling is an extreme measure, Boyd said, pointing out that the debased gasoline will bring a recurrence of wartime annoyances and difficulties to millions of motorists who, for the first time in 5 years, are hoping to heed the call of the open road and see postwar America.

The CPA's conclusions must be modified before May 1 or they will result in the decreased efficiency of millions of automobiles, trucks, and buses, in the forced "reconversion" of the nation's refineries, and in the disruption of the marketing machinery of the petroleum industry, thus inflicting enormous economic penalties that cannot have been foreseen by the CPA, Boyd said.

"Decreased allocation of lead to the petroleum industry is a blow to every motorist," he declared. "It is futile to grant permission to oil companies to produce 80-octane gasoline without allocating sufficient Ethyl fluid with which to make it. Many passenger cars, buses, and trucks that have been adjusted to the use of postwar motor fuels of higher quality, will face readjustment to poorer grades of fuel and at a cost to the owners that in the aggregate is incalculable.

"In effect, the petroleum industry is penalized for its unselfish cooperation through the Petroleum Administration for War in helping to relieve the lead shortage in other industries by agreeing immediately after V-J Day to accept an allocation of lead insufficient for its needs in the last quarter of 1945.

"A curtailment of the lead supply for gasoline and the consequent dislocation of the petroleum industry would result in far reaching penalties throughout the national economy in this critical year. Construction of new refineries or changes in old refineries to provide other means of achieving gasoline quality require large investments, large amounts of materials, and a great deal of time."

● **COMPACT ENLARGES ITS ECONOMIC COMMITTEE.** The Interstate Oil Compact Commission has enlisted the aid of some of the nation's top ranking economists to keep it advised of economic trends in the oil and gas industries, it has been announced by Earl Foster, commission secretary.

"The compact's economics advisory committee, originally composed of 3 members, has been revised and enlarged to better keep the commission constantly informed on all economic factors relating to oil and gas," Foster said. "The membership of the committee has been increased to 9 and a group of 4 councillors to the committee has been appointed. The committee members, all nationally and internationally known economists, are R. J. Gonzalez, chairman, Humble Oil and Refining Company, Houston, Texas; J. H. Salmon, Shell Oil Company, Inc., New York; John Boatwright, Standard Oil Company of Indiana, Chicago, Illinois; James V. Brown, Independent Petroleum Association of America, Washington, D. C.; A. J. McIntosh, Socony-Vacuum Oil Company, Inc., New York; H. J. Struth, Texas Mid-Continent Oil and Gas Association, Dallas, Texas; Sidney A. Swensrud, Standard Oil Company of Ohio, Cleveland, Ohio; Fred Van Covern, American Petroleum Institute, New York, and Clarel B. Mapes, Mid-Continent Oil and Gas Association, Tulsa, Oklahoma.

"The group of councillors to the committee, most notable of present-day petroleum economists," Foster continued, "is composed of Alexander Sachs, New York; Joseph E. Pogue, The Chase National Bank, New York; E. DeGolyer, DeGolyer and MacNaughton, Dallas, and Stewart P. Coleman, Standard Oil Company of New Jersey, New York. Pogue, Sachs, and DeGolyer were the 3 members of the original economics committee and have served the compact since 1938.

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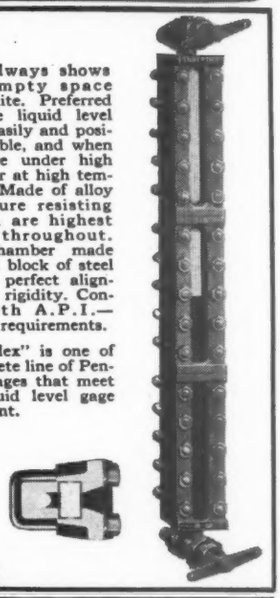

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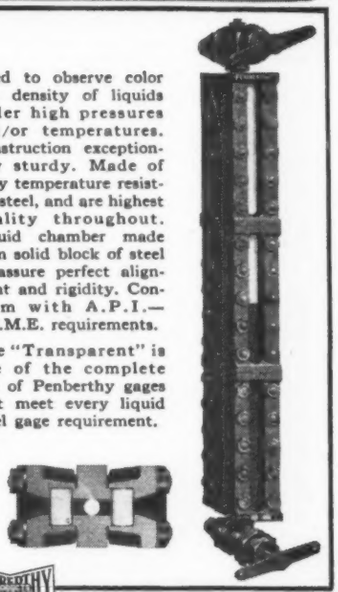

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MAJOR *Oil Field* ACTIVITIES

● **WYOMING.** When Pure Oil Company was about to abandon its No. 1 wildcat on the River Dome structure in Washakie County, 9 miles north of Worland, because of water encountered in the Big Horn lime at 11,379 ft., a heavy gas flow was brought in during a drillstem test in the Embar at plugged back depth of 9,990 to 10,050 ft. An estimated flow of 400 bbl. per day of greenish-amber colored oil testing 41.8 gravity came with the gas.

● **OKLAHOMA.** R. H. Dearing and Sons No. 1 McBride, NE NW NW, 30-4-2w, is a prospective pool opener in Garvin County. Gas, estimated at between 3 and 5 million ft., and a spray of oil were recovered on a drillstem test. Total depth of the well is 6588 ft. The recovery was from the basal Pennsylvania sand zone.

A new oil field in the Yeager district of northern Hughes County has been opened by Otha H. Grimes of Tulsa at his Meadors No. 1, in SW SE SE, 23-8n-10e. Cromwell sand was topped at 3397 ft. and drilled to 3435 ft. On initial test the well did 50 bbl. of oil an hour through tubing chokes.

Southern Creek County has a new oil pool with William M. Dunn's No. 1 Walker, NE NE SW, 30 14 10e. It picked up saturated Dutcher sand at 2944 ft., and on a drillstem test made gas in 3 min. and 1500 ft. of oil through ½ in. choke.

● **OREGON.** The Texas Company is drilling a wildcat on the outskirts of Portland. The well, Cooper Mountain No. 1, has been drilled to 7862 ft. and casing set to stop caving while drilling deeper.

● **LOUISIANA.** Continental No. 1 Cameron Parish School, 16-15s-14w, is a prospect for a new pool for the Johnson's Bayou area of Cameron Parish. The well was being perforated to test the 9200-ft. level after squeeze cementing. The test is at a total depth of 9302 ft.

The California Company has announced the discovery of a new oil field in Jefferson Parish. The new field, known as Bayou De Fleurs, is 4 miles southeast of the producing area at Barataria. The discovery well. E. P. Brady No. 1, flowed from a depth of 9366 ft. at the rate of 288 bbl. a day. It was bottomed at 10,680 ft.

● **TEXAS.** A Young County strike, McKutchin No. 1 G. C. Clayton, has opened a new oil field for that area. The well gaged 120 bbl. on ¼-in. choke in 10 hr. from the Caddo lime at 4,69-96 ft.

Fain-McGaha No. 1 O. H. Chapman opened a new field in Archer County, one mile east of Holiday. In sand at 4125-38 ft., the well flowed naturally 120 bbl. in 15 hr.

Bee County has indications of a new oil pool at Bridwell Oil No. 1 Sliva Estate, a wildcat test 9 miles southwest of Beeville. The well recovered 210 ft. of oil, with a little mud, on a 20 min. drillstem test at 4377-87 ft. in the Stillwell sand. Total depth is 4555 ft.

A new Edwards lime pool is looming in Caldwell County. The wildcat, Ogden B. Klein No. 1 Dr. E. Smith, 6 miles southeast of Lockhart, penetrated the Edwards lime at 2665 ft., then cored 4 ft. of saturated formation and 3 ft. farther into the Edwards with a good showing of oil.

An old failure on the east side of the North Goldsmith pool, northwestern Ector County, is appearing as a Devonian discovery well. The well is Stanolind Oil and Gas Company's No. 1 Grisham-Hunter (R. B. Cowden), which formerly was drilled to 6499 ft. and abandoned.

Zimmerman-Garcia No. 2 Garcia, about 4000 ft. northwest of the recent Parson area discovery, in the Rincon field, is a prospective pool opener for Starr County. Testing the first of 3 oil sands, a good oil recovery on a drillstem test in the lower sand led to initial production attempts there. Total depth is 3493 ft.

The showings in the Magnolia Petroleum Company No. 1 R. Steele wildcat in southwest Foard County may open a new lime field there. Operators drilled to the Ellenberger at 5666-82 ft. A 1 hr. test showed 900 ft. of salt water. On drillstem test at 5,22-30 and 5322-36 ft. free oil was recovered.

A new gas-condensate pool has been opened 2½ miles northwest of East Barnard, Wharton County. The well, Cockburn Oil Corporation's No. 1 W. H. Burns, was estimated as producing 50,000,000 cu. ft. of gas in the Sparta sand of the Cook Mountain series at 8118 ft.

A Jones County wildcat is showing as a discovery well. Oscar Donley of Fort Worth No. 1 Roy E. Pritchard has a reportedly good oil show at 2550 ft., and in the Hope, Flippen, and Cook formations.

Humble Oil and Refining Company's No. 1 Lydia Vick, 2 miles west of Polar in southwestern Kent County, West Texas, shows indication of being a pool opener. On a drillstem test of the Ellenberger at 7780 to 7812 ft., the wildcat recovered 2,96 ft. of oil and 6 ft. of drilling mud in 1 hr., with a good showing of gas.

A new pool has been opened 3 miles southwest of Buffalo Springs in southern Clay County of North Texas, at L. T. Burns No. 1 J. E. Ford. The well has been completed to flow 70 bbl. of oil in 3 hr. from the Caddo lime. Total depth is 6701 ft.

Youngblood and Foree No. 12 Joe Benton has opened a new Bend conglomerate oil pool for western Montague County in North Texas, 3 miles northwest of Stoneberg. The casing was perforated with 60 shots from 6132-42 ft. in the Bend conglomerate zone of the Caddo lime and the well flowed 67 bbl. of better than 40 gravity oil in 30 min. Total depth is 6243 ft.

Prospective Simpson, middle Ordovician, discovery in northwestern Grayson County, between Gordonville and Sherman, is Denver Producing and Refining Company No. 1 Jewell. This wildcat had approximately 75 ft. of Simpson sand, well saturated, that was penetrated at 8468 ft. Total depth is 9413 ft.

A San Jacinto County pool has been opened by Fred M. Manning No. 1 Central Coal and Coke, 2½ miles southwest of the Mercey pool. The well rated a potential of 14.5 bbl. of 52.0-gravity condensate and 280,000 cu. ft. of gas daily through 13/64-in. choke. It was drilled to a depth of 10,814 ft.

When the wildcat of W. Y. Penn, Midland, was brought in to flow naturally 1 bbl. of oil an hr., a shallow sand discovery for North Pecos County appeared assured. The well, W. T. Shearer, N/4 of 41-10 H&GN, averaged that flow on a 24-hr. test from sand at 1945 60 ft.

DeWitt County has a new oil field at Pure Oil No. 1 Karl wildcat, ½ mile south of Pure's No. 1 Rice gasser and 2 miles southeast of Yoakum, about ½ mile from the Lavaca County line. The well was perforated at 8663-65 ft. and gauged 130 bbl. of 34-gravity oil.

A new field in Jones County has been opened at H. L. Hunt's No. 1 Leonard McCoy, 1½ miles north of Hedges. It had the Gunsite lime at 2570 ft. and pumped 145 bbl. of oil the first 24 hr.

● **KANSAS.** Atlantic Refining Company's No. 1 Carmichael, 16 9 17, opened a new oil pool in Rooks County. The well made 35 bbl. a day on the pump from the Lansing-Kansas City lime. Total depth is 3446 ft. The pool is known as the Nyra pool.

A new producing horizon was found in the Arnold pool, Ness County, by the Sohio Petroleum Company's No. 3 Drake, NW SW NW, 26-16-25. The well made 275 bbl. a day on pump from the Fort Scott lime. Total depth is 4523 ft.

● **RUSSIA.** Near the Suvorovskoe settlement in the Province of Grozny, U.S.S.R., new petroleum deposits have been discovered, according to the foreign press. One well is producing large quantities of oil, it is stated; 2 more wells were being drilled in December.

● **CALIFORNIA.** A probable new discovery for Kern County is Independent Exploration Company No. 2 Temblor, 17-29s-21e. The wildcat flowed 1500 bbl. of 17.9-gravity oil a day. Top of the Carneros sand was at 2790 ft. and total depth at 2828 ft.

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MAJOR *Pipe Line* ACTIVITIES

● **312-MILE LINE.** A contract for construction of 312 miles of products pipe lines in the states of South and North Dakota and Minnesota by Great Lakes Pipe Line Company of Kansas City, Missouri, has been awarded to H. C. Price Company, of Bartlesville, Oklahoma. The line will begin at Sioux Falls, South Dakota, and run northeast to Marshall, Wilmer, and Alexandria, Minnesota. At this juncture the survey then turns west to Fargo, North Dakota, and from this point it runs due north, terminating at Grand Forks, North Dakota. This pipe line extends perhaps farther north than any gasoline line in the United States and is designed to meet a shortage of gasoline in the area. Construction work will begin early in May and the company expects to complete the line before September 1.

The Price organization is now completing extensive pipe line construction work in the southeast for the Southern Natural Gas Company.

● **REQUEST PENNSYLVANIA-NEW YORK LOOP.** Iroquois Gas Corporation, Buffalo New York, and the United Natural Gas Company of Oil City, Pennsylvania, have made application to the FPC for permission to construct approximately 20 miles of 16-in. loop line from "Maloney Farm By-pass" of United, situated about 2½ miles south of the Pennsylvania-New York State line to "Little Valley By-pass" of Iroquois, Cattaraugus County, New York. Total cost of this project is estimated at $330,000. The proposed loop will complete an integrated pipe line system composed of 4 continuous parallel pipe lines through which Iroquois obtains delivery of part of its natural gas requirements from United.

● **AUTHORITY GRANTED TO OPERATE.** West Texas Gas Company, Lubbock, Texas, has been granted permanent authority by the FPC to operate facilities constructed under a temporary permit. The facilities consist of about 11 miles of 10¾-in. loop line in Hale County, Texas, and an additional 400-hp. compressor unit at the company's McSpadden compressor station in Randall County, Texas, and necessary appurtenances. The purpose of the additions is to provide more adequate service to the company's present customers in Texas, which include about 44 communities served at retail and a number of industrial customers, the Southwestern Public Service Company, Motor Fuels Corporation Refinery, Postex Mills, Arizona Chemical Company, Lubbock Army Air School, and Midland Army Bombing School.

● **KENTUCKY PIPE LINE.** FPC has set May 6 as the date for hearing on Cincinnati Gas Transportation Company's application for authority to construct and operate a 70-mile Kentucky pipe line. The proposed 14-in. pipe line will extend from Cincinnati Gas Transportation Company's 20-in. pipe line near Foster, Kentucky, to a proposed interconnection with the 24-in. pipe line of Tennessee Gas and Transmission Company near Means, Kentucky. Total cost of the construction is estimated at $1,500,000. According to the application, the additional pipe line is needed to augment the capacity of existing facilities for delivery of natural gas to meet increased demands of present customers, The Cincinnati Gas and Electric Company, Cincinnati, Ohio, and the Union Light, Heat and Power Company, Covington, Kentucky.

● **CONTRACT AWARDED.** Stanolind Pipe Line Company has awarded contract to R. H. Fulton and Company, Lubbock, Texas, for construction of approximately 35 miles of 16-in. pipe line. The line extends from Stanolind's Wasson station in Yoakum County, Texas, to its Slaughter station in Hockley County, Texas.

● **GOVERNMENT LINES.** Trans-Continental Gas Pipe Line Company, Inc., of Longview, Texas, has filed application with the FPC for authority to convert the "Big Inch," the "Little Inch," and the "Southwest Emergency" pipe lines to the transportation of natural gas to Pennsylvania, New Jersey, and New York or permission to construct a comparable pipe line system for gas transportation. The application states Trans-Continental has offered WAC $40,000,000 for the lines, excluding pump stations, and proposes to expend $40,000,000 to convert the lines to gas usage. The alternate proposal, in case the company is unsuccessful in purchasing the lines, is to construct a 26-in. pipe line of 300,000,000 cu. ft. per day capacity from Corpus Christi, Texas, to Linden, New Jersey, at an estimated cost of $80,000,000.

● **BID FOR "BIG INCH" AND "LITTLE BIG INCH."** Big Inch Gas, Inc., and Big Inch Oil, Inc., are two new corporations that have been joined by Charles H. Smith, former chairman of General Waterworks and Electric Company, for the purpose of bidding for the federal government's "Big Inch" and "Little Big Inch." This offer, which also includes the Southwest Emergency Pipelines, is the second offer made by private interests for the lines. The new offer contemplates using the "Big Inch" line to carry natural gas from Carthage field in northeast Texas to New York City. The "Little Big Inch", companion line, will be used to transport crude oil and other products from Beaumont, Texas, to Linden and Bayonne, New Jersey. The company has offered to pay $40,000,000 for the Big Inch line alone.

● **KANSAS CITY-OMAHA LINE.** Great Lakes Pipe Line Company has announced that construction of an 8-in. gasoline pipe line from Kansas City to Omaha will begin about April 15 and be completed about July 1. The line will have pumping stations at Atchison, Falls City, and Nebraska City.

● **PLAN NEW LINE.** A 108-mile 8-in. pipe line is being planned by Pasotex Pipe Line Company, subsidiary of the Standard Oil Company of California, through its affiliate, the Standard Oil Company of Texas. The line will give additional crude facilities in the West Texas Permian Basin for its plant at El Paso and will be used to extend the company's system from Winkler County to the Yates pool of Pecos County.

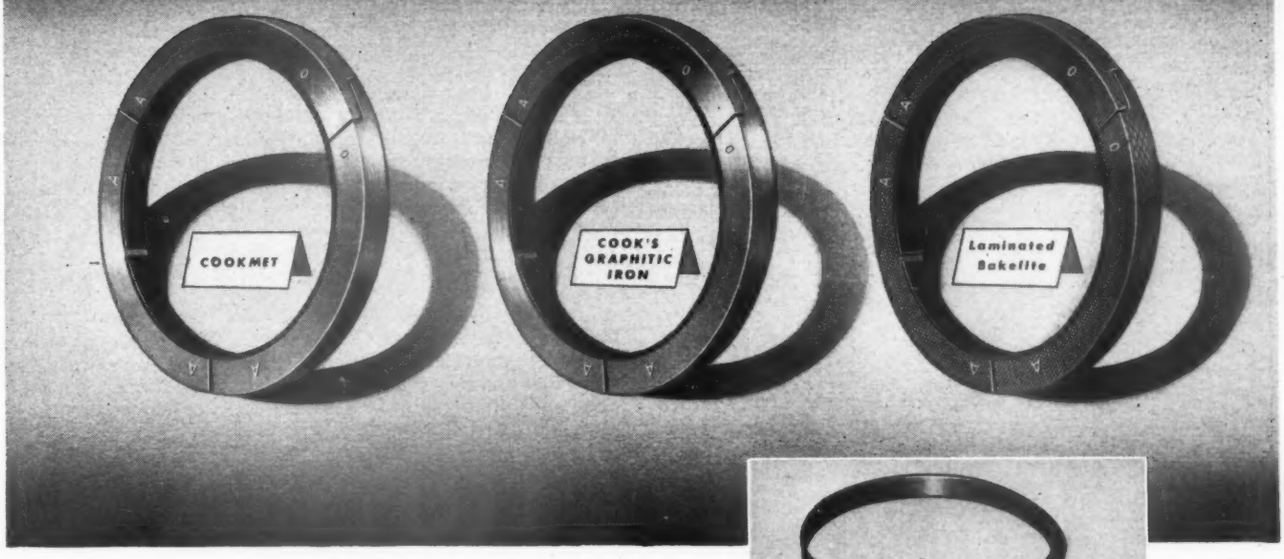
● **EXTEND SYSTEM.** Panhandle Eastern Pipe Line Company has proposed a 2-year $27,313,000 construction program to the FPC. The company said that the program would enable it to deliver 90,000,000 cu. ft. of gas daily to markets through its pipe line system. The system extends to Texas, Oklahoma, Kansas, Missouri, Illinois, Indiana, Ohio, and Michigan.

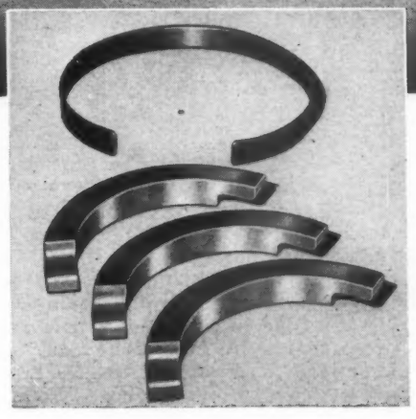
● **LINE TO MONTERREY.** The Mexican Gas Company has purchased a 14-in. pipe line from the United Gas Company, Shreveport, Louisiana, that will deliver natural gas from Roma, Texas, to Monterrey, Mexico. Prisciliano Elizondo, president of Mexican Gas, said $2,000,000 will be spent to construct another parallel line from Roma to Monterrey. The pipe line will deliver 45,000,000 cu. ft. of Texas gas daily to the industrial center of Monterrey and will give the company a total daily delivery of 80,000,000 cu. ft.

● **HEARING POSTPONED.** The hearing on an application of the Metropolitan Eastern Corporation for a certificate to construct and operate a gas pipe line has been indefinitely postponed by the FPC. The proposed pipe line is an 825-mile 18-in. line extending from the Carthage gas field in Panola County, Texas, to the vicinity of Hamilton, Ohio. The project would have an initial daily capacity of 140,000,000 cu. ft. of gas and is estimated to cost $23,500,000. The postponement was requested by the company.

● **AWARDS CONTRACTS.** Humble Pipe Line Company has awarded contracts to construct the company's gasoline products line from Baytown to a point in the Fort Worth-Dallas area. France Construction Corporation of Corpus Christi received contract to lay 127 miles of 8-in. pipe from Baytown to Hearne. O. R. Smith Construction Company of Fort Worth was awarded contract for 150 miles of 8-in. from Hearne to the terminal.

COOK'S SEGMENTAL COMPRESSOR RINGS





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MAJOR *Refining* ACTIVITIES

● **CONSERVE NATURAL GAS.** Sun Oil Company has launched a $4,000,000 program to conserve natural gas that will involve the construction of 9 processing plants, according to an announcement by James E. Pew, manager of the company's natural gas and natural gasoline division. A natural gasoline plant, and possibly a gas storage compressor plant, is scheduled for construction in the Sun and North Sun fields in South Texas, involving an expenditure of about $1,000,000. The company is joining other operators in the Seeligson field, South Texas, in constructing a gas cycling and natural gasoline plant, in which Sun's investment will amount to more than $2,000,000. Pew said work has already begun on 2 of 4 small pressure-maintenance plants in other South Texas fields. In Michigan, a pressure-maintenance plant costing about $125,000 will be built, and in Louisiana plans for a natural gasoline plant in the Delhi field are being developed.

More than 65,000,000 cu. ft. of gas daily will be conserved by the program, Pew said.

● **STANDARD LEASES 100-OCTANE PLANT.** Standard of California has leased a portion of the government owned 100-octane plant at Bakersfield, California, and will operate approximately one-third of the facilities. The company will maintain the remainder for the RFC, which retains the right to dispose of the idle portion at any time. Standard's lease is for a minimum of 2 years and is subject to cancellation by either party on 1 year's notice. The plant is a wartime unit declared surplus by RFC.

● **TOLUENE PLANT.** Humble Oil and Refining Company has purchased all usable facilities of the Baytown Ordnance Works toluene plant at Baytown, Texas, the first plant of its kind to be erected for the production of toluene from petroleum, from the War Assets Corporation for $6,948,394 in cash. Humble was the wartime operator of the plant and produced only toluene, a chemical required for the production of TNT, but will now use the plant for production of petroleum products, chiefly gasoline components. Because of the highly specialized processes used in making toluene from petroleum, the plant will require extensive conversion of its facilities.

● **EXPANSION PROGRAM.** Continental Oil Company's refinery at Wichita Falls, Texas, is undergoing expansion and modernization improvements costing approximately $250,000. New equipment being installed is designed to increase the plant's crude refining capacity from 5000 to 6000 bbl. a day. Upon completion, the refinery will further convert to production of high octane gasoline.

● **OIL REFINERIES FOR SALE.** The War Assets Corporation has offered the following refineries for sale or lease: Two, Ponca City, Oklahoma, formerly operated by Continental Oil Company; Norwalk, California, operated by Wilshire Oil Company; Bakersfield, California, operated by Mohawk Petroleum Corporation; Coffeyville, Kansas, operated by Cooperative Refinery Association; near Texas City, Texas, operated by Southport Petroleum Company of Delaware; Houston, Texas, operated by Eastern States Petroleum Company of Texas; Pasadena, Texas, operated by Central Petroleum Corporation.

● **$1,000,000 FIRE.** A fire and 4 explosions ruined a $1,000,000 unit of the Pure Oil Company refinery at Heath, Ohio. The first explosion occurred in the high-pressure reducing unit used for converting oil to gasoline. Fire and debris shot high into the air and, as the flames spread to a smaller reducing unit, 3 more explosions occurred. There was no official estimate of damage. The destroyed unit cost $1,000,000 to build 7 years ago, when it was constructed as a replacement for a unit that had burned.

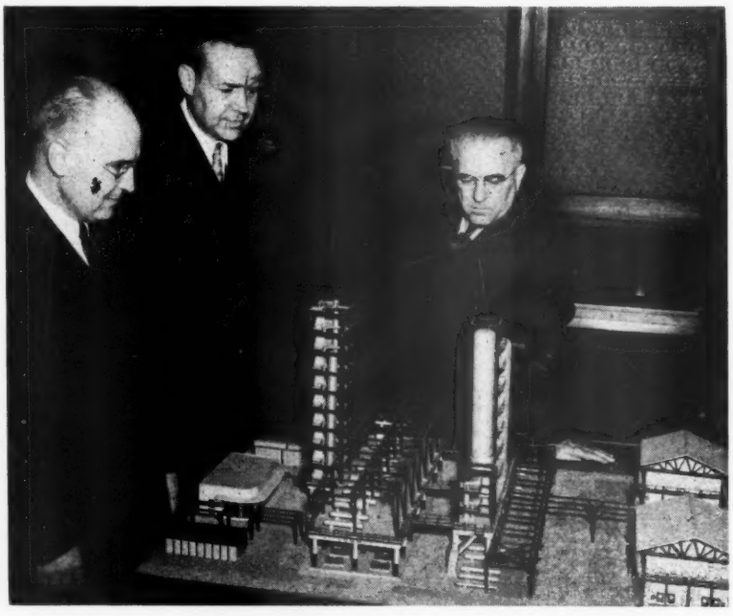
● **ADDITION TO LUBE REFINERY.** Consumers Cooperative Association, Kansas City, Missouri, has announced an expansion program at its Coffeyville, Kansas, refinery. This program includes the installation of a furfural refining unit and a vacuum distillation unit for the production of high quality lubricating oil. The contract for this work has been awarded to Process Engineers, Inc., Dallas, Texas. It is expected to be completed in 9 months at a cost of approximately $1,000,000.

● **NAVY HOLDS ONLY ONE REFINERY.** The only refinery in the country now under Navy control is the American Liberty Refinery at Texas City, Texas. The Gulf Oil Corporation refinery at Port Arthur, Texas, was the latest unit to be released.

● **SHELL LUBE PLANT.** Shell Oil Company, Inc., will begin construction immediately on a complete lubricating oil manufacturing plant, first of its kind to be built since V-J Day. The plant will cover 75 acres of land in the 650-acre tract purchased last year to provide for postwar expansion and will be situated next to Shell's present refinery on the Houston Ship Channel.

The new lube plant will be an addition to the extensive construction project now under way at Houston that includes a 17,000 bbl. per day catalytic cracking unit, gas recovery and treating equipment. The new lubricating oil facilities will consist of 5 plants of latest design, according to P. E. Foster, manager of the Houston refinery. Included in the installation will be plants for vacuum distillation, deasphalting, solvent extraction, dewaxing, and chemical treating. In addition to the processing equipment, at least 10 separate buildings will be required to house various auxiliary facilities of the new plant and additional outside equipment will include storage tanks and loading facilities. The plans also call for a number of pilot plants in which improvements in lubricating oil manufacture, developed by laboratory research, may be tested under operating conditions before being used in quantity production.

Foster said that contracts for construction had been awarded to The Lummus Company and M. W. Kellogg Company.



P. E. Foster (right), manager of Shell's Houston refinery, O. M. Morfit (left) of the M. W. Kellogg Company, and W. W. Kraft (center) of the Lummus Company examine a model of a vacuum distillation unit similar to one that will be installed in the large lubricating oil manufacturing plant soon to be constructed in Houston for Shell Oil Company. The M. W. Kellogg Company and the Lummus Company are contractors for construction of the new plant.

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PLANT ADDITIONS INCREASE BUTANE RECOVERY

By **FRANK H. LOVE,** *Managing Editor*

LATEST additions to Continental Oil Company's interconnected plants in the K.M.A. field, Wichita County, Texas, were made primarily to increase butane extraction, the secondary result being an increase in the percentage of casinghead gasoline recovered. By the addition of certain equipment, a better than 90 per cent butane recovery has been effected.

EXCLUSIVE

The arrangement of Continental's 3 hydrocarbon extraction-pressure maintenance plants is rather unusual. The set-up consists of the Main Plant and two auxiliary plants situated several miles distant. Distillation equipment is centralized at the Main Plant. A part of the producing wells are connected directly to the Main Plant, others are tied into Auxiliary Plant No. 1 and Auxiliary Plant No. 2, which are equipped with compressor units and absorption columns. Lean oil is circulated to these auxiliaries from the Main Plant and the rich oil returned there for processing. The stripped gas is returned to the producing formation directly from the several plants. A limited volume of casinghead gasoline is recovered at the auxiliary plants by means of compression and refrigeration and this is piped to the Main Plant for stabilization.

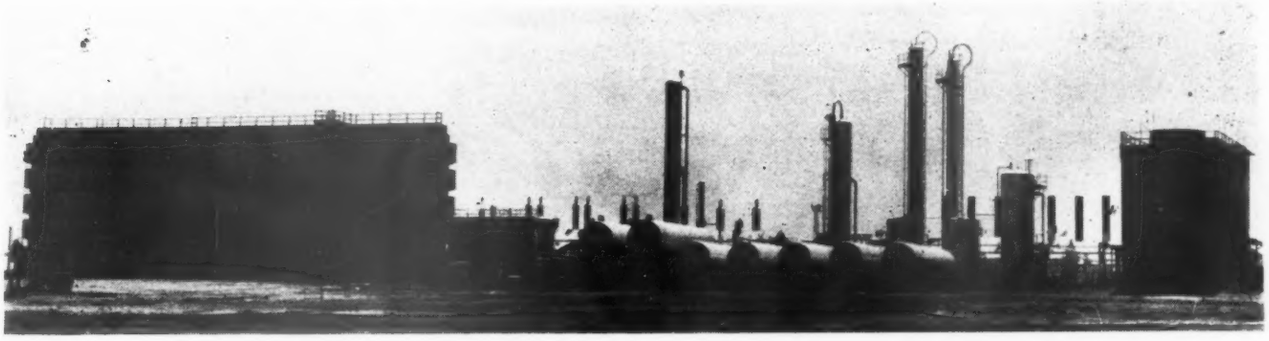
When the 3 plants were first constructed in 1939, the only gasoline recovered was through compression. Compressor horsepower has since been added as the field developed until now the Main Plant contains 8 units, the No. 1 Auxiliary Plant 8, and the No. 2 Auxiliary Plant 13 units.

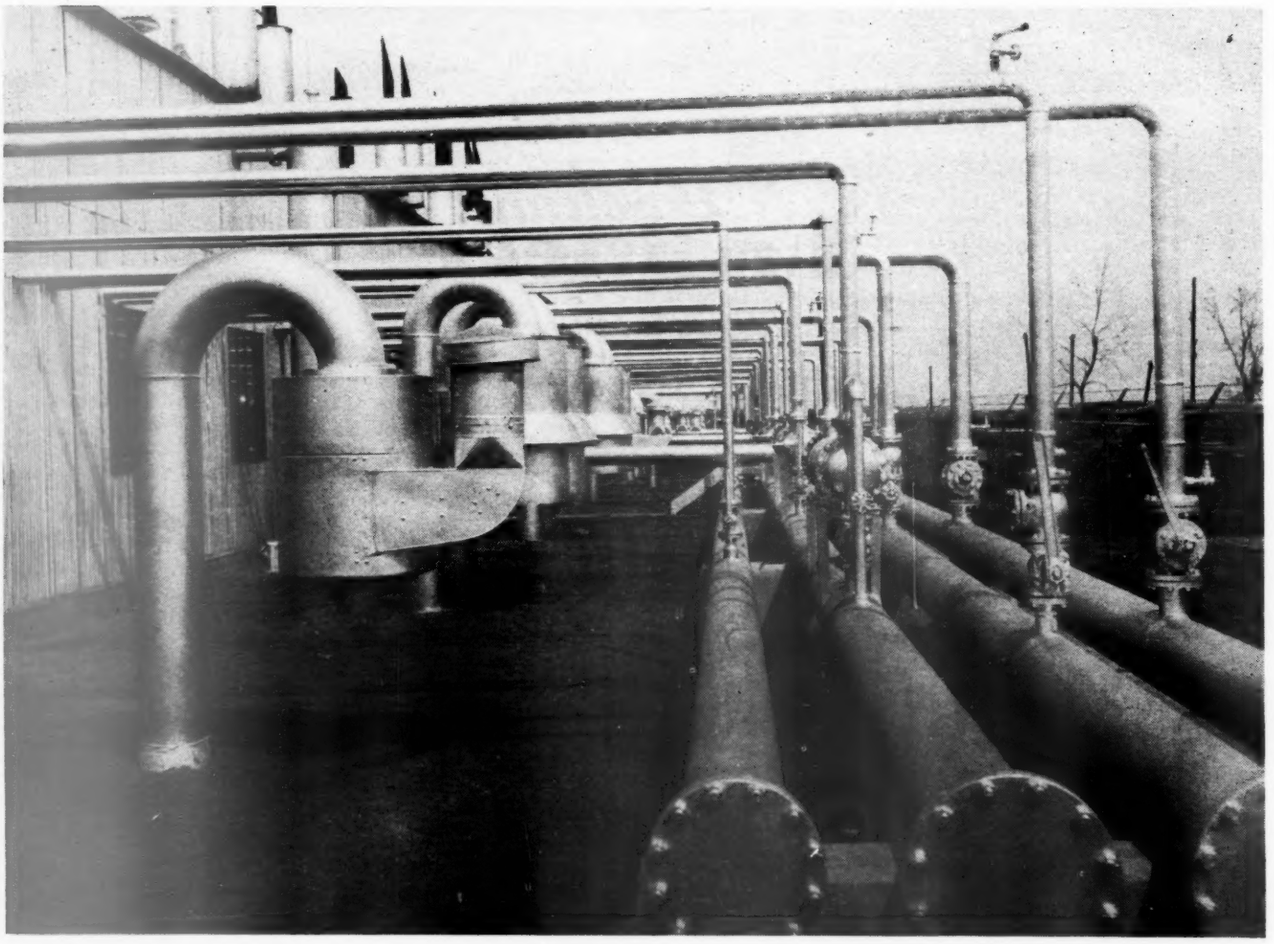
During its evolution of growth a refrigeration system was installed at the Main Plant and Auxiliary No. 2. The systems employ propane as the refrigerant, lowering the temperature of the gas to between 0°F. and minus 10°F., at an operating pressure of 250 lb. per sq. in., thus condensing out part of the hydrocarbon fractions.

The latest construction has added an absorption and distillation system that processes the gas for additional extraction. At the Main Plant and Auxiliary No. 2 absorption is used after compression and refrigeration and at Auxiliary Plant No. 1 after compression alone.

● **New equipment. Main Plant.** The recently completed construction program added to the Main Plant a 24-tray absorber column, 3 ft. 6 in. in diam. by 66 ft. 6 in. high. The centralized distillation equipment consists of a rich oil still (6 ft. diam. by 48 ft.), flash tanks and heat exchangers, rich oil stabilizer (4 ft. diam. by 70 ft.), and an absorption oil

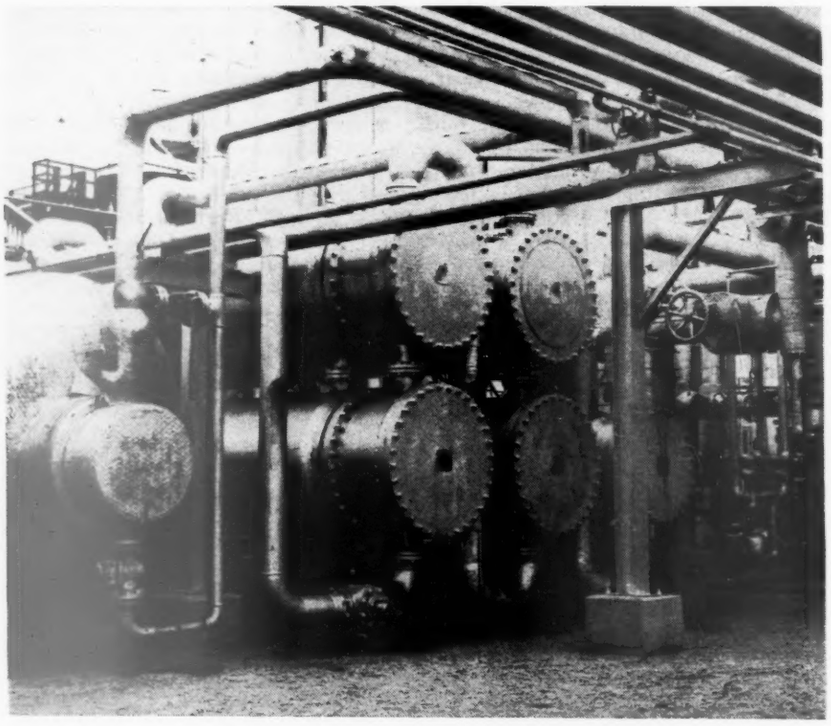
General view of Continental Oil Company's Main Plant, K.M.A. field, Texas.





Above—Air filters and headers at Auxiliary Plant No. 1.

Below—Preheater and heat exchangers serving the still.



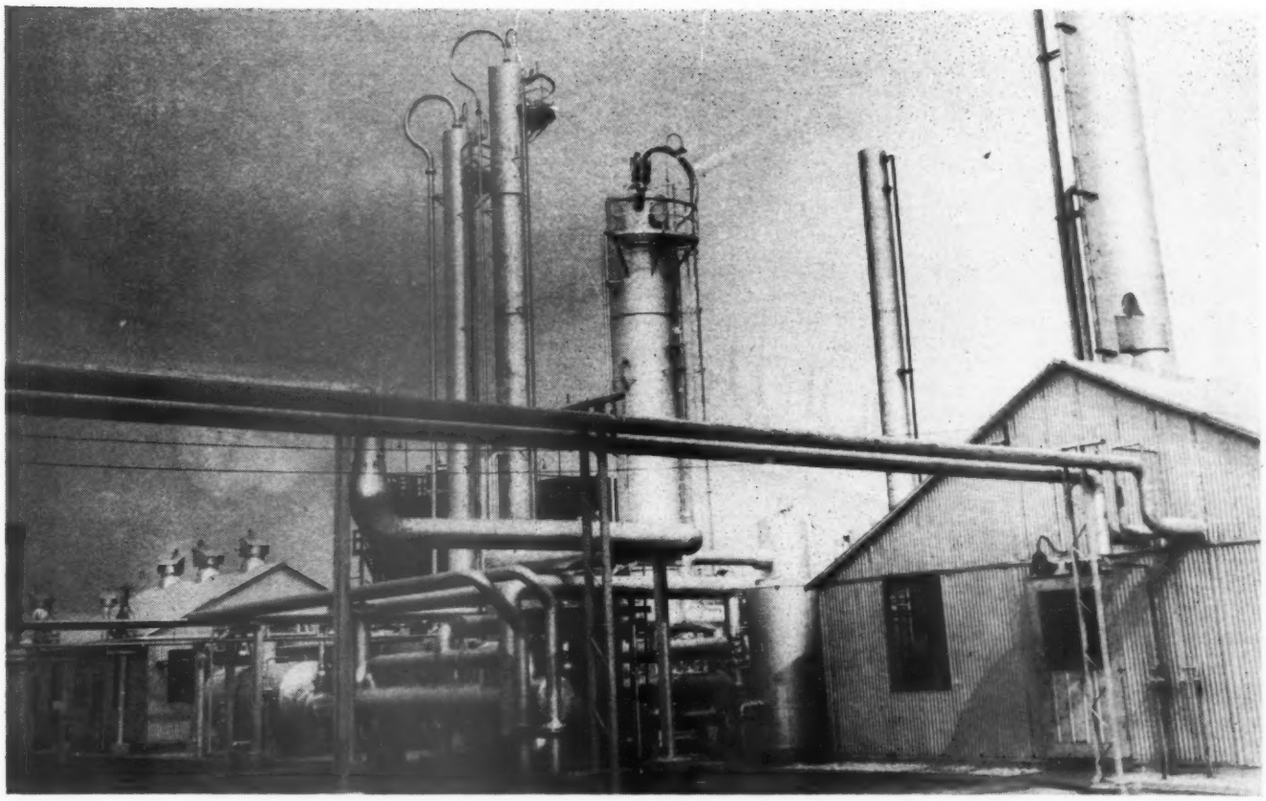
chiller that maintains the lean oil at a temperature of approximately 65°F. Installed also at the Main Plant as an essential part of the absorption system were an 8-bay induced draft cooling tower having a capacity of 2300 gal. per min.; five 125-hp. boilers having a working pressure of 250 lb. per sq. in., and a 6-stage centrifugal lean oil pump for circulating absorption oil to the two auxiliary plants. The lean oil pump is driven by a 300-hp. gas engine and has a capacity of 125 gal. per min. A single-stage centrifugal pump for circulating cooling tower water is driven by this same gas engine. The capacity of the cooling tower pump is 7000 gal. per min. In connection with the boiler installation, a boiler feed pump and feedwater exchangers were added.

Two steam direct-driven duplex reciprocating pumps (14 in. by 6 in. by 12 in.) are provided, one for oil circulation to the absorber and the other to serve the rich oil stabilizer. Two centrifugal still reflux pumps are steam turbine driven and have a capacity of 250 gal. per min. each. Additional electrical power is supplied by a 50-kw. steam-turbine-driven generator.

Exhaust steam from the two reciprocating pumps mentioned above is used for process steam in the still. These pumps operate with 100-lb. exhaust.

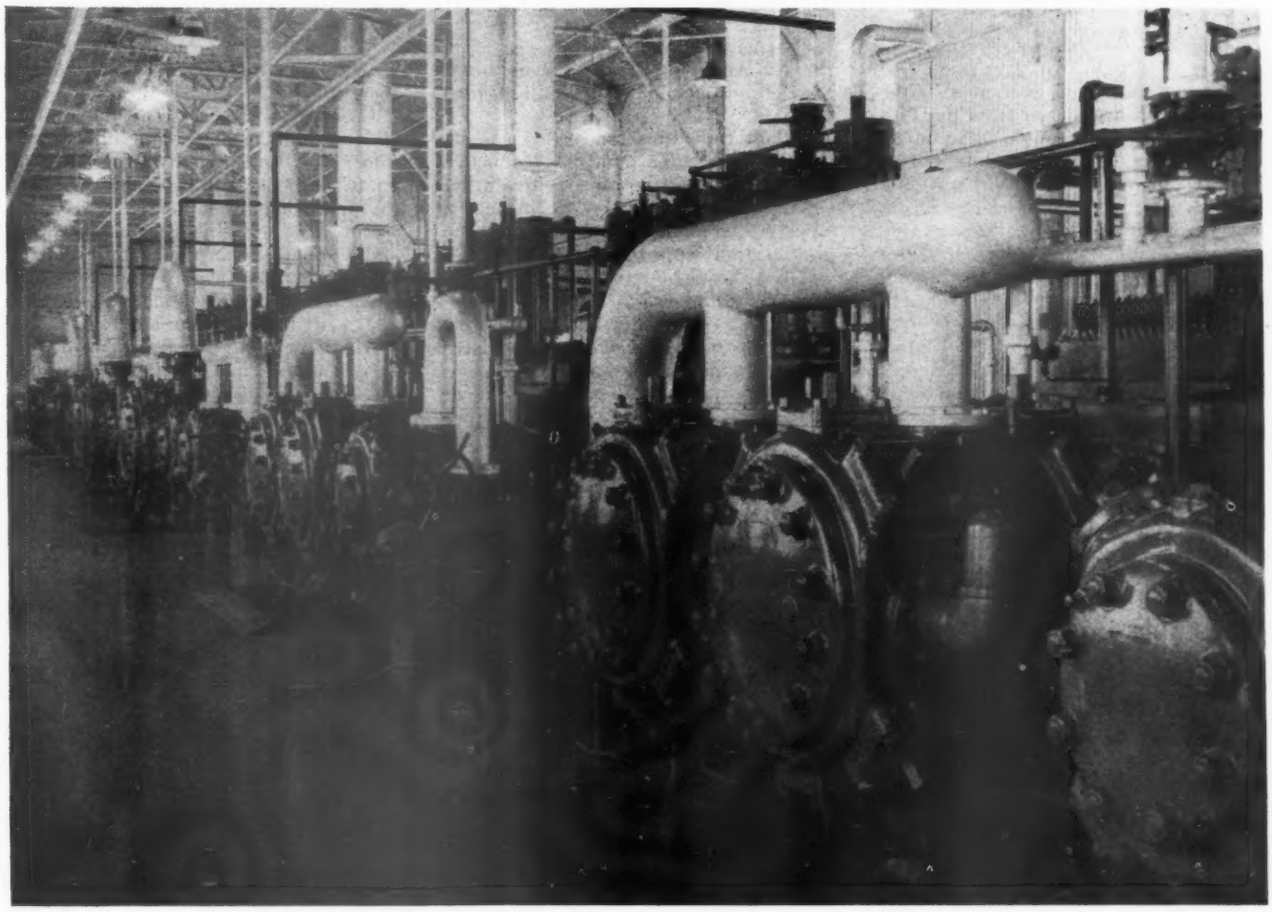
● **Auxiliary Plant No. 1.** At Auxiliary Plant No. 1 two new 600-hp. angle-type compressors were added, as well as one 400-hp. unit that was moved from Auxiliary Plant No. 2 where less compressor horsepower is now needed.

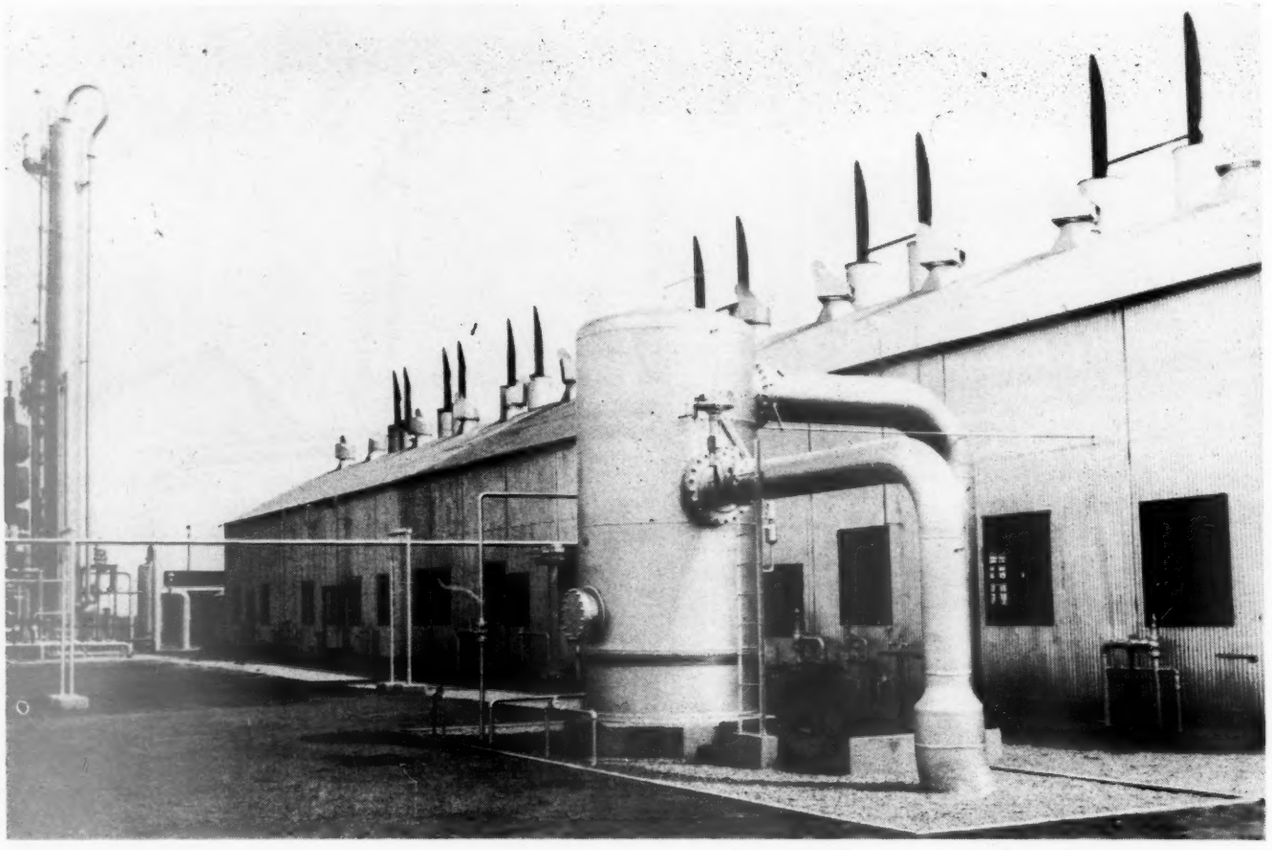
A 4-ft. 6-in. by 70-ft. 24-tray absorber



Above—New absorption and stabilizing equipment at Main Plant, showing still, rich oil stabilizer, and absorber.

Below—Compressors in the Main Plant, of which there are eight—two being 230-hp. horizontals, five 400-hp. angles, and one 800-hp. angle. The three plants return 7,200,000 cu. ft. of gas a day to producing formation.





New inlet scrubber (foreground) and 24-tray absorber (background) at Auxiliary Plant No. 1

was added at this plant, operating at a pressure of 270 lb. An interesting feature of the absorption equipment is the removal of absorption oil from the 14th tray and the subsequent cooling in an intercooler in the cooling tower before returning the oil to the absorber.

A new 7-ft. by 10-ft. inlet gas scrubber operates at a pressure of 6 in. of vacuum. To handle new cooling facilities (jacket water and gas cooling coils, and lean oil intercooler), a 4-bay extension was made to the atmospheric cooling tower. The pump for the lean oil intercooler is a motor-driven centrifugal unit.

Requisite to tying in additional wells to the plant, approximately 9 miles of field gathering lines were laid, ranging in size from 6 in. to 16 in. diam. Necessary, also, was the laying of 22,000 ft. of 4-in. line to take the lean oil from the Main Plant to Auxiliary Plant No. 1 and the same length of 6-in. to transport the rich oil back.

● **Auxiliary Plant No. 2.** Less new equipment was needed at Auxiliary Plant No. 2 than at either of the other plants. Already equipped with a greater number of compressors, one unit was transferred to Auxiliary Plant No. 1, as already stated. An absorber was added at the No. 2 plant, a 24-tray unit measuring 4 ft. in diam. and 66 ft. 6 in. high. The absorber operates at a pressure of 275 lb. per sq. in.

A 5-ft. by 16-ft. lean oil chiller that uses propane as a refrigerant holds the oil temperature to 55°F.

To carry the lean oil from the Main Plant to Auxiliary Plant No. 2 and bring the rich oil back, 53,000 ft. of 4-in. pipe was laid.

● **Plant capacities.** The rated gas capacity of the three plants is 46,353,000 cu. ft. a day, and the rated repressuring capacity is 9,760,000 cu. ft. Actually, however, the plants are processing at the present time approximately 29,000,000 cu. ft. a day, and returning to the producing formation 7,200,000 cu. ft. Because of the widely fluctuating load over a 24-hr. period, it is necessary to have installed considerable capacity in excess of the average daily volume handled.

By plants the rated capacity is as follows: Main Plant, 12,060,000 cu. ft.; Auxiliary Plant No. 1, 17,403,000 cu. ft., and Auxiliary Plant No. 2, 16,893,000 cu. ft. The rated repressuring capacity is 3,020,000 cu. ft., 3,660,000 cu. ft., and 3,080,000 cu. ft. for the plants in the order above named.

Breaking down by plants the volumes of gas actually handled, the Main Plant is processing 4,500,000 cu. ft. a day and returning 1,700,000 cu. ft. to the producing formation, Auxiliary Plant No. 1 is processing 14,000,000 cu. ft. and injecting 2,000,000 cu. ft., and Auxiliary Plant No. 2 is processing 10,500,000 cu. ft. and returning 3,500,000 cu. ft. In view of the still increasing volume at Auxiliary Plant No. 1 and of the decreased volumes at the Main Plant and Auxiliary Plant No. 2, it is now planned to move additional compressors from these plants for reinstallation at Auxiliary Plant No. 1 to handle the increased gas volume there.

Casinghead gas is being taken from 1024 producing wells and injection is into 71 key wells. An average of 101,408 cu. ft. a day per well is being returned to the producing formation.

To carry out this gasoline recovery and pressure maintenance program the Main Plant has 8 compressor units, two being 230-hp. horizontals, five 400-hp. angles, and one 800-hp. angle.

Auxiliary Plant No. 1 also has 8 compressor units, 3 being of 400 hp., 4 of 600 hp., and 1 of 300 hp.

With a total of 13 units, Auxiliary Plant No. 2 has two 230-hp. horizontals, six 400-hp. angles, two 600-hp. angles, and three 200-hp. horizontals.

The compressors operate at an intake pressure of approximately 6 in. of vacuum, compress the gas to an absorption pressure of 250 lb., and to 1400-1800 lb. for injection into key wells.

● **Manufactured product.** The plant's manufactured product is PBC stock (propane, butane, casinghead gasoline). As this product comes off the stabilizer at the Main Plant it is pumped through a pipe line about 20 miles to Wichita Falls where Continental Oil Company has a refinery. At the refinery the PBC stock is fractionated into its components.

● **Contractor.** The contractor for the recent work was Jones and Laughlin Construction Company of Tulsa, Oklahoma. ★ ★ ★

SAFE PRACTICES FOR HAND TOOLS

By **DON ATTAWAY**, *Safety Engineer*, Arkansas Louisiana Gas Company

EXCLUSIVE

A review of accidents occurring in the petroleum industry for the last few years shows that 8 per cent of them are directly connected with the use of hand tools. In other industries, the figure is not so high, as only 6.15 per cent of all other industrial accidents can be charged to hand tools. This condition becomes more understandable in view of the fact that the oil and gas industry makes use of nearly all known hand tools in its operations and uses them most of the time under unfavorable or hazardous conditions.

In careful analysis of the hand tool accidents, the cause has been found divided between unsafe acts and unsafe conditions. In 39.2 per cent of the injuries, an unsafe act resulting from lack of knowledge has been found responsible, whereas in 60.8 per cent of the cases, a faulty mechanical or physical condition has been the direct cause.

The seriousness of hand tool accidents can be recognized when it is known that 10 per cent of them result in injuries to the eye. More than 25 per cent involve injury to the hand, thumb, or fingers. The loss of a finger or hand is serious indeed, but the loss of vision is a terrible misfortune.

Ordinarily, moving parts of power-driven tools can be completely guarded and hazards eliminated, but the use of common hand tools is an operation that cannot be approached by mechanical guards. A common reason why such injuries occur is the belief by workmen that simple hand tools are harmless. Such is not the case, and the accident and death records prove the fact.

● **Tool material.** In discussing hand tools, it is well to consider the material from which tools are made. Too often purchasing agents do not realize the hazard produced by tools of inferior or cheap make, or the actual loss of time or materiel due to poor quality. There is no economy or safety in having anything but the most suitable and dependable tools. Chisels, wrenches, shovels, and files made from poor stock soon crack, break, dull, or mushroom into discard or eventually produce a painful accident.

● **Tool handles.** Tools requiring handles should have the best. Frequently an oil or gas company will buy cheap handles for shovels, picks, hammers, and other tools in order to realize a slight savings. Such a handle may break and a workman be seriously injured by a flying head, or a splintered handle may be the cause of a lacerated hand. The handles of all tools should be the best of straight-grained material, free from slivers, and made of hickory, ash, or maple.

Some workmen wrap friction tape on tool handles to prevent slipping. This is permissible if the handle is of good material and the tape so placed that it will not slip or throw the tool out of balance.

The fitting of the handle in the tool requires skill and care. Only an experienced person should install such handles. If nails or screws are used to wedge handles, there is possibility of an injury.

● **Open-end wrenches.** The open-end wrench is in common use in the oil and gas fields and it is the tool involved in most of the hand injuries. This wrench has the head and opening at an angle to the body, usually 15 deg. It is made this way so that when turning a unit in a tight space, it can be flipped over after each stroke to reverse the angle of the head and it will fit the next two flat sides of the nut. This trick permits continuous turning of the nut in a limited space. For pulling up flange bolts, the open-end wrench is the safest and fastest wrench to use.

There are a few simple rules for the correct use of end-wrenches.

See what happens when a workman uses unsafe practices. A wrench slip may mean a bad injury.

A discarded file is unsafe for use as a chisel. It breaks easily when struck with hammer.

Worker is using unsafe tool in incorrect manner. Such practice leads to accidents.

1. Be sure the wrench fits.
2. Always pull, if possible.
3. If conditions require pushing, be sure to use the base of the palm and hold your hand open.

● **Adjustable wrenches.** The adjustable wrench is shaped somewhat like the end-wrench, but has one adjustable jaw. The angle of the opening to the head is about 22½ deg. These wrenches are very handy at times, but are not intended to take the place of the standard open-end wrench. They are not suitable for heavy, hard service.

When extra force must be exerted on an adjustable wrench, there are two safety points to remember.

1. Always place the wrench on the nut so that the pulling force is applied to the stationary jaw side of the handle.
2. After the wrench is placed on the nut, always adjust the knurl so that the wrench fits snugly.

Adjustable wrenches must be kept clean. Give them frequent baths in solvent and apply a little light oil to the knurl. Inspect frequently for cracks or sprung jaws and replace damaged parts.

● **Monkey wrench.** The monkey wrench does not receive the credit it deserves. It is very good for hexagonal end valves and fittings. It fits better and does not have the crushing effect of a pipe wrench. It is never used on pipe or round parts, as its jaws have no means of gripping such shapes. Too often a pipe wrench is used on jobs that belong to the monkey wrench and too often the monkey wrench is used for the job a hammer should do.

● **Pipe wrench.** The teeth of a pipe wrench always leave their mark on the work. It should never be used on nuts, threaded bolts, or parallel-sided objects. It is designed for use on pipe and screwed-end fittings only. A pipe wrench can be worked only in one direction. The harder you pull, the tighter it squeezes, if the jaws are clean and sharp. Dull jaws and teeth, dirt, grit, sand, or oil on the pipe can cause the wrench to slip.

Pipe wrenches come in sizes from 6 to 48 in. Each size is designed for certain pipe or work. The most common error with pipe wrenches is the use of "cheaters" or nipples slipped over the handle for an extension to give extreme leverage. Always use a wrench large enough for the job. The small sizes will not stand the extra pressure of a cheater.

Pipe wrenches should never be used on pipe of more than 5-in. diam. This is a job for pipe tongs.

Always keep jaws clean and sharp. A few drops of oil on the adjusting nut makes it work easier.

A pipe wrench works better when the "bite" is taken near the center of the jaws.

● **Tongs.** Snap-on tongs are more desirable than scissor tongs for laying pipe. The scissor tongs should always be carried in closed position. Faulty or slipping tong keys should be replaced immediately.

Pipe tongs should always be set on the pipe no farther than one-fourth the length of the joint from the threads and each additional pair should leave ample working space for the crew.

Raising tong handles higher than the shoulders and riding them to the ground is bad practice.

The handle or point man on a pair of tongs should be experienced and should exercise care when setting the tongs on the pipe, as well as in operating the handles to cause the tong keys to bite and hold the pipe.

Chain tongs should be handled with care and the fingers kept from underneath the chain or jaw. They should be set on the pipe with just enough chain slack to allow proper leverage and easy latching.

When the tongs hang on the pipe or the chain has been fastened too tight, a sharp blow on the slack of the jaws with a heavy hammer will loosen them.

● **Hammers.** The hammer is the commonly used hand tool and has been called "the thumb-buster." There are many types of hammers, each suited for some specific work but many workmen fail to realize this.

A machinist hammer is not designed for driving nails, nor is the carpenter hammer suitable for machinist work.

The carpenter hammer has a bull's-eye driving face to prevent nails from flying. Machinist hammers are beveled or rounded at the edge of the face to reduce mushrooming.

The face of either of these hammers should be parallel to the axis of the handle. A cocked head or handle will always cause a hammer to slip or miss.

Neither of these hammers should be used to strike tempered or case-hardened tools or metal. A soft hammer made of brass, lead, rawhide, copper, or wood will prevent steel particles from flying.

Sledge hammers come in weights for certain classes of work. These hammers frequently lose their heads. This can be

prevented by placing a wrought-iron strap or clamp over the head and fastening to the handle with two bolts. The clamp should be welded to head where it passes over the sides.

● **Box wrenches.** Box wrenches are very popular with engine mechanics. They can be operated in close quarters. Some have the heads set at 15-deg. angle to the handle, which gives a clearance for the hand when the head is set flat on the upright nut.

The best practice for box wrench use is to discard it after the nut or bolt has broken loose. Too much time is lost in resetting the box for each turn. An open-end or adjustable wrench is safer and quicker on running off the nut or bolt.

The box-end striking wrench is the only wrench that can be hammered. It is designed for heavy work generally found around compressors. The handle is short and has a pad on which the hammer blows are struck. The box should completely enclose the nut to keep it from flying off.

A variation of the box wrench has an open end and this combination wrench is very popular and easy to use.

● **Socket wrenches.** The socket or "speed wrench" is a favorite for the mechanic. To use this wrench safely, the correct size is selected and placed on the ratchet handle. Then the socket is slipped over the nut. Inside the wrench head is a pawl or dog that engages one or more of the ratchet teeth. Pulling on the handle one way turns the socket. Moving the handle in the other direction permits the handle to back up without moving the socket.

This wrench is suitable for Dresser couplings and seldom involves an accident. Any failure comes from overstraining, improper fitting, and incorrect handling.

● **Cutting tools.** Keen-edged cutting tools such as axes, hatchets, and adzes should always be kept sharp as they are safer and more efficient than dull tools. For carrying such tools, a leather case is desirable, however, when walking with the tool exposed it should be gripped with the hand directly behind the head on the handle. Accidents result from these tools from leaving them where workmen may step or strike against them. A good practice in right-of-way or pipe line crews is to drive the tool into a block of wood when not in use. This imbeds the cutting edge and reduces exposure.

● **Hack-saws.** The hack-saw has had a part in numerous accidents and invariably the cause has been found to be a lack of knowledge on the part of the operator and a resulting misuse.

The hack-saw handle and frame must be kept in good, clean condition.

The proper blade must be selected for the job to be done and the correct tension put on the blade. A slack, loose blade on rough work usually breaks promptly under strain.

The first cut or set of the saw should be on the up-stroke.

After the job is finished, the tension on the blade should be released and the saw returned to its regular place.

Do not use a hack-saw on wood.

A hack-saw cannot stand twisting or heavy pressure. A light, even stroke with the handle held in the right hand and the head held in the left hand makes smooth operation.

● **Chisels.** Cold chisels should never be used unless the operator is wearing goggles. The cold chisel must have a sharp cutting edge and the head must be round and firm. Mushroomed heads on chisels are dangerous. The best practice is to saw off the damaged part. Grinding down the mushroom does not remove the soft, damaged metal.

The safe way to hold a chisel is between the thumb and first finger with the chisel laying across the upturned palm. This permits better vision of the working area and the chisel head. To grasp the chisel in the clenched fist exposes the bones of the knuckles to a hammer blow.

Concrete or bull chisels should be held by means of tongs when in use.

● **Pliers.** Pliers are too often used for the work of a heavy wrench. They are intended for light work that can be done on small fittings. They should have the handles well taped to give gripping surface and to provide protection from live electrical circuits.

When cutting wire or springs under tension, always take hold of the wire close to the cutters and stand so that the ends cannot fly into the face.

● **Files.** Every file requires a good handle. The sharp tine can make a painful wound.

A file should never be struck with a hammer or used as a pry-bar. It breaks easily and pieces of hardened steel are likely to fly. The metal is too brittle to make a chisel or punch out of an old file.

The cleaner you keep a file the less chance there will be for it to slip.

● **Screw drivers.** The screw driver is a tool frequently connected with an accident. Misuse and lack of knowledge or skill is usually found as a cause.

All screw drivers require good handles. Insulated handles are desirable

All files require handles. The tine can puncture a hand.

Workers should keep safe distance between the shovel handles.

Home-made tool devised to carry acetylene bottles.

A worker at a grind or emery wheel requires goggles.

where work is done around electric circuits, although this does not always guarantee protection. A roughened or splintered handle causes blisters and an opening for infection. A slipping screw driver while the user is pressing hard against the handle can cause a serious injury. Some screw drivers have ribbed points to engage the inside surface of the screw and the point is locked in slot.

The practice of using the screw-driver as a pry, punch, or chisel results in a bent shank or rounded points and makes it unfit for use.

Screw drivers come in sizes for the work they are to do and the correct size for the job should always be used.

● **Jacks.** Accidents involving jacks are usually serious. The "kick" of a jack has been known to kill men and improper centering and cribbing of loads has crushed men to death. Numerous finger and hand injuries are caused by the falling head of a lifting jack.

Jacks must always be set on solid footing and after the load has been lifted blocking of sufficient strength must be placed under it before any work is begun.

Never leave a jack standing under load with the handle in socket. Something may strike the handle and cause load to fall or safety pawl to break.

● **Electric hand tools.** Portable electric tools are frequently used in machine shops, compressor stations, and gasoline plants, and there are certain unsafe conditions to be avoided.

Defective cord insulation, improper or poor terminal connections, defective plugs, loose switches, and sparking brushes should be repaired at once.

It is a good safe practice to use a ground wire to the casing of the tool if a grounding circuit is not provided. A clip on this wire makes it easy to snap on any independent ground such as a water pipe or foundation bolt.

Do not use a portable electric tool in any place wherein inflammable vapors are known or suspected.

● **Digging tools.** There are more than 50 different types of shovels. The important thing is to fit the shovel to the job and the man to the shovel. Good, smooth, secure handles are most important. The cutting edge must be sharp and the tool balanced.

Shovels left laying around create a stumbling hazard. They should always be stacked or stuck in the ground.

Picks should have the head securely fastened to the handle. Many injuries result from the loose head of a pick, when in highest position over the worker's head, sliding down the handle and striking the man's head or pinching his fingers.

Foreman should observe workmen to determine whether their use of the ditching tool is correct. Often improper and incorrectly used shovels and picks result in blisters, or strained and pulled muscles.

Ditchers should be spotted about one joint of pipe apart. If conditions require two men in a common ditch, they should be no closer than 6 ft.

● **Tool boards.** A substantial, well-designed tool board is a great asset in preventing hand tool accidents. It encourages workmen to return tools after use and thus prevent them from becoming scattered on floors and walkways. It prompts workers to keep tools clean and in good repair.

● **Protective equipment.** In using numerous hand tools such as chisels, picks, and concrete drills, the wearing of goggles is imperative. In any operation where flying parts or pieces, splash, or dust may be encountered, the eyes require protection.

Gloves should be worn when using shovels, picks, or heavy hand tools.

In operating jacks and hoists, the use of safety-toe shoes in desirable.

Snug fitting clothes and hard-hats are very appropriate in most oil and gas operations.

● **General.** This article cannot cover all hand tools nor list every hazard of those mentioned. It is intended to cover only the most generally accepted practices that frequently lead to accidents. The safe use of any hand tool depends largely upon the user and his attitude toward self-protection. and his habits or behavior, as well as the attention his supervisor gives to his actions, and the amount of instructions or training the worker receives.

Generally speaking, the safe use of all hand tools depends upon four simple rules. They are:

1. **Use the right tool for the job.**
2. **Use it in the correct manner.**
3. **Keep it in good condition.**
4. **Put it away after use.**

It is quite evident then, that if a worker does not understand the use of his tool, he should ask for instructions. A good supervisor and a trained worker following the above rules will eliminate hand-tool accidents and create profit for themselves and the company.

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DEVELOPMENT OF POSTWAR OIL REFINING*

By **EUGENE R. SMOLEY** and **VERNON O. BOWLES**
The Lummus Company

An analysis of postwar marketing situation and its effect on refining processes.

In an article published about one year ago[1], the writers attempted to analyze and predict postwar marketing situations and their effect on petroleum refinery processing on the basis of trends and information then available, as well as to illustrate methods of determining the most profitable selections of processes required for refinery modernization programs. In this article an attempt will be made to amplify these earlier discussions on the basis of the developments that have taken place during the last 12 months.

The refining industry lost little time in swinging from the all-out war production program to meet the marketing conditions imposed by a combination of residual war requirements and an unrationed public eager to enjoy again the pleasure of unrestricted driving and well heated homes. The industry can look with pride upon the accomplishment of fulfilling the difficult market requirements imposed by the overnight change when hostilities were terminated and rationing of gasoline and distillate fuel was abruptly discontinued. The refining industry is now passing through a period of continually changing economy, which will not become substantially stabilized until the international political situation as well as our domestic industrial conditions become reasonably settled. Although the oil industry seems to be working out its labor problems satisfactorily and has obtained well stabilized manufacturing conditions, its domestic markets on the other hand will reflect existing unsettled conditions in the basic manufacturing industries resulting from strikes and widespread shortages of material. For example, the delay in the production of automotive equipment will have a pronounced bearing upon the demand of gasoline and lubricating oils by the public, and work stoppages in the steel and electrical industry will result in reduced requirements for petroleum products. The political gyrations of the United Nations Organization and of various international oil commissions will continue to delay active rehabilitation and expansion of foreign properties. In addition, political disturbances such as have been taking place in certain localities will slow progress in these areas. The net result of all these domestic and international disturbances will be a curtailment of crude processing through 1946. It is probable, however, that in 1947 there will be an upturn in crude run resulting from an increase in domestic as well as foreign consumption of refined products.

● **World-wide considerations.** Toward the close of the war, the United States was refining about 5,000,000 bbl. per day of petroleum and foreign countries were refining nearly 2,000,000 bbl. per day. Had the war lasted through 1946, it was expected that there would have been a total world-wide demand for petroleum of approximately 7,500,000 bbl. per day. These values compare with a world-wide prewar petroleum crude run of about 6,000,000 bbl. per day in 1941. Current trends indicate that during 1946 the petroleum refining rate will probably drop to approximately 4,400,000 bbl. per day for the United States and 6,300,000 bbl. per day world-wide. After international political conditions become more stabilized, and as soon as it becomes possible to market petroleum products on an economic basis, the market for all petroleum products in foreign fields will build up rapidly, probably as early as 1947, and will continue to expand for at least several years. The fact that the consumption of refined petroleum products in the United States has averaged approximately 9 bbl. per capita whereas the foreign consumption has averaged something less than ½ bbl. per capita indicates the tremendous potential for increased use of petroleum products in foreign fields. Of interest in this regard is the fact that at the close of the war approximately 73 per cent of all petroleum was refined in the United States, 12 per cent was refined in the Caribbean area, 8 per cent in the Near and Middle East, 3 per cent in Canada, and approximately 2 per cent was refined in Mexico and South America. Inasmuch as there is a great potential market in every foreign country including Russia, China, and all the nations of Europe as well as the Pan American countries, it is predicted that during the next decade there will be a great expansion of petroleum refining facilities abroad in order to supply these growing markets. Today American interests own 66 refineries abroad with an approximate total capacity of 875,000 bbl. daily. United States' interest is 20 per cent in the Middle East, 48 per cent in South America, and 35 per cent in all foreign countries. American technologists will continue to play an important role in the development of these foreign projects and a considerable amount of American capital will be invested. There looms on the construction horizon 4 refineries to be built in the Caribbean area; there will be refinery expansion in the Persian Gulf and the Netherlands Indies, also in Latin America besides Venezuela, and in Canada. The other region due for great activity is the Caspian Basin. This will be carried out by Russia with some American engineering assistance and equipment. As soon as automobile manufacture is in full swing, it is predicted that average crude requirements in the United States will increase approximately 125,000 bbl. per day each year. On the basis of a present domestic crude production of approximately 4,400,000 bbl. per day, it is expected that a deficiency will develop in about 1947 making the importation of crude necessary in increasing amounts thereafter. This crude will probably be imported from the Caribbean and Persian Gulf areas.

● **Motor and aviation gasolines.** With few exceptions the total demand in the United States for gasoline of all grades has increased every year. This increase amounted to approximately 4 per cent annually during each of the 4 years preceding the war and in 1940 the gasoline demand reached a quantity of 1,700,000 bbl. per day. Our participation in the war caused an increase in this demand to 1,900,000 bbl. for 1941 and to a peak of approximately 2,000,000 bbl. per day in 1944. During 1944 and early 1945 more than 700,000 bbl. per day of gasoline were produced for military requirements. This total included the production of more than 500,000 bbl. per day of 100-octane aviation gasoline at the peak in the year 1945. Although gasoline rationing resulted in the release of a sub-

[1] "Some Considerations of Postwar Petroleum Refinery Operations," *The Petroleum Engineer*, May, 1945.

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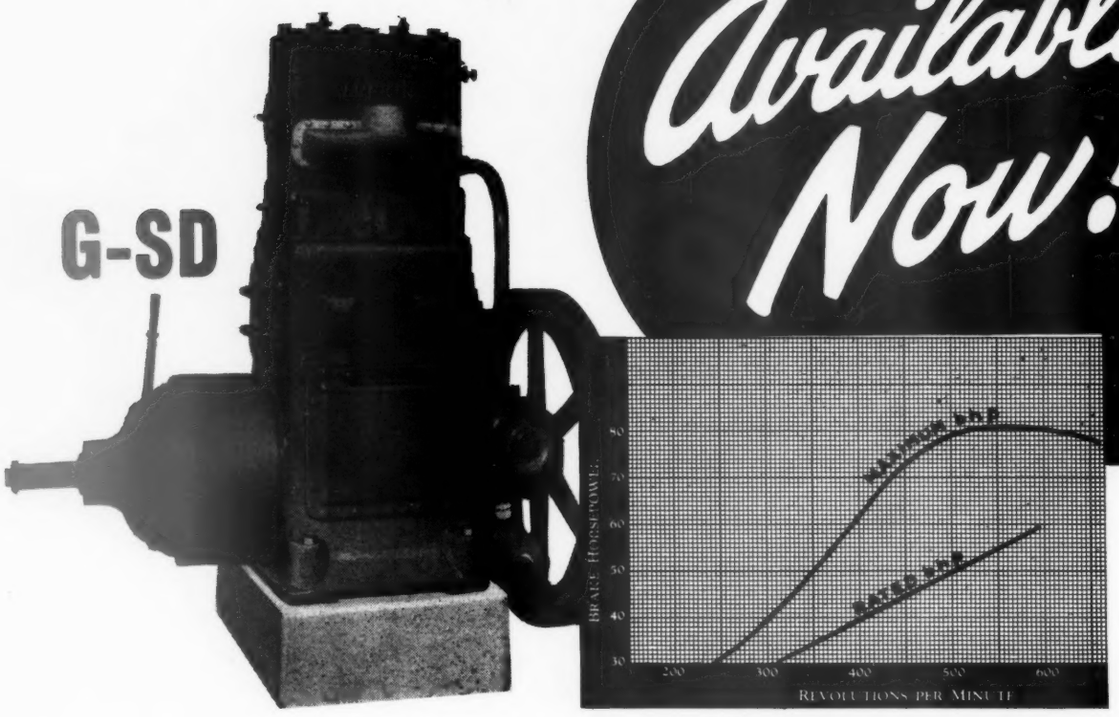

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stantial quantity of the gasoline required for the military effort, it might be said that the major portion of this gasoline was obtained by virtue of sharply increased crude runs, which rose more than 1,000,000 bbl. per day to a peak of approximately 5,000,000 bbl. during the war years. The industry's ability to expand its refinery crude runs by such a substantial amount with only minor investment in new crude processing facilities is indicative of its ability to accommodate greatly increased demands for petroleum products during the next several years. With the facilities now available, the industry can process approximately 20 per cent more crude than the anticipated 4,400,000 bbl. per day for 1946, and with the new facilities in the course of construction and planning domestic crude runs approaching 6,000,000 bbl. per day could be achieved. With this crude rate the normal gasoline production would be approximately 2,300,000 bbl. per day.

The tremendous catalytic cracking capacity that was installed during the war years for the 100-octane aviation gasoline program has already reflected itself in motor gasoline quality. It appears now that premium grade gasolines will approach 85 ASTM motor method octane number during 1946, whereas regular grade will reach approximately 80, and third grade nearly 70. During the octane race of the prewar years, premium grade gasoline reached 80.2 octane number, regular 74.4 octane, and third grade 65.6 octane number in 1941[2]. These octane values were sharply reduced during the war to 76, 72, and 55, respectively, in order to facilitate the production of maximum 100-octane aviation gasoline. Catalytic cracking capacity in the United States at the present time amounts to approximately 1,000,000 bbl. per day with nearly 100 plants in operation or under construction. The significant fact about this is its distribution. These 100 plants are situated in only about 50 refineries of the 400 in the United States. The remaining 350 refineries with no catalytic units process more than 40 per cent of the petroleum refined in this country and with few exceptions these refineries run less than 20,000 bbl. per day of crude. Most of these small refiners are giving serious consideration to the installation of facilities that will enable them to meet competition. Some of these refiners are fortunate enough to have available crudes that yield gasoline of suitable quality, but many, on the other hand, are already beginning to meet with difficulties in marketing their products. In at least 3 small refineries, catalytic cracking plants ranging in capacity from 3000 to 6000 bbl. per day are now in the course of design or construction. These refiners were able to justify the installation of small catalytic cracking units not only on the basis of improved gasoline yield and quality but on the basis of increased overall yield of liquid products and reduced production of residual fuel oils. Some refiners are meeting competition by reforming naphthas. The polyform and non-regenerative hydroforming processes afford further means for enabling the refiner to increase his octane levels.

By 1947 it is predicted that the automobile industry will begin producing engines designed for higher compression ratios resulting in more economical use of premium grade gasolines. This development will be a gradual one and during its initial stages will not exert a great influence on the gasoline market; first because the percentage of high compression cars will be small for quite a while, and second because owners of old cars are still purchasing a large amount of premium fuel. At the present time 40 per cent of all motor gasoline sold is of premium grade as compared to 10 per cent in 1941. This change is undoubtedly due to the desire on the part of car owners to employ the best quality fuel available in order to extend the life of their car and to obtain better performance. This tendency seems to be so great that even the 91-octane motor gasoline offered at certain pumps in California for a short period of time late last year, before the OPA forced its discontinuance, received a very active public acceptance. In view of all these considerations, there appears to be little doubt that automobile manufacturers will produce high compression units designed to utilize economically gasoline of 85 to 90 ASTM octane number within the next 2 or 3 years.

In the field of aviation gasolines, it is predicted that there will be a gradual increase in consumption from the 35,000 bbl. per day prewar level up to approximately 125,000 bbl. per day by 1955. It is possible that there may be a limited usage of super-fuels having higher octane than the military 100-octane aviation widely used during the war; however, present indications are that there is little to be gained by any increase in quality above 100 octane. Jet propulsion engines designed to move planes at sonic speeds already appear to be displacing the gasoline powered radial engines employed in military pursuit and attack planes. Inasmuch as jet propulsion research is only in its infancy, it appears certain that kerosine powered jet propulsion engines will completely displace gasoline powered radial engines for nearly all military aircraft except possibly heavy bombers and reconnaissance planes. As metallurgical research provides the materials to permit higher temperature operation in jet propulsion units and thereby improves their efficiency, it is entirely possible that these engines may also enter into the commercial aircraft field. Such developments will tend to reduce the requirement for 100-octane aviation gasoline and increase the demand for kerosine type fuels.

● **Distillate and residual fuel oils.** Although crude runs were increased by approximately 1,000,000 bbl. per day during the war years, and although there was on the whole sufficient aviation and motor gasoline for military requirements, there was a substantial deficiency of both distillate and residual fuels during this period. This deficiency was corrected only at the expense of reducing the inventories of these fuels to extremely low levels by the end of the war. There is a rapidly rising trend toward the use of distillate fuels for home and industrial heating requirements as well as for stationary and mobile diesel power units. The average demand for distillate fuels during the 5 years preceding the war increased by about 8.5 per cent annually indicating the rapid growth in the use of these fuels for domestic and industrial heating. It is anticipated that the total consumption of distillate fuels in 1950 will be nearly double that of 1940. This rapid increase in distillate fuel requirements will be partly met by the addition of catalytically cracked distillates and partly through increased refinery crude throughputs. Catalytic cracking of a large quantity of material that in the past has found its way into residual fuel oils will provide a significant part of the increased motor gasoline and distillate fuel requirements; however, this will probably bring about a deficiency in residual fuel oil supply. Although there have been periods in the past when it was not possible to market all the residual fuel oils associated with gasoline market requirements, resulting in excessively large residual fuel oil inventory build-ups such as occurred in California during the middle 1930's, no such condition is again likely to arise regardless of the demands for other products. On the contrary, it is expected that the demands of increased industrial activity will bring about increased requirements for residual fuel oils. Any deficiency in residual fuel oil requirements will be met by additional refinery crude throughputs and it is probable that the marginal crude processed will be made up largely of imported low gravity crudes. In general, it appears that the refining industry will encounter no difficulties in balancing its overall market requirements for several years to come. Use of existing catalytic cracking, coking, deasphalting, and vacuum reduction facilities should enable refiners to balance the nation's gasoline, distillate fuel, and residual fuel requirements up to the extent of a total crude throughput in the range of 5,000,000 to 6,000,000 bbl. per day.

● **Lubricating oils and waxes.** Although there was a vast program for construction of refining facilities primarily for the production of aviation gasoline during the war years, very few new facilities were installed for the manufacture of high grade lubricating oils. During the war years it was possible to meet the military requirements for lubricating oils with the plants available. Last year the writers summarized the lubricating oil situation describing the acceptance and growth of solvent refining during the decade preceding the World War. The large program for construction of new solvent refining and dewaxing plants for lubricating oil pro-

[2]These octane values are Bureau of Mines arithmetic averages for winter 1940-41 of 21 districts of the U. S.

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Moscow to have additional natural gas

The 530-mile pipe line that will carry natural gas from Saratov field to Moscow should be in operation at this time if the date scheduled for its opening, January 1, 1946, was met. The gas, by increasing Moscow's fuel supply, will do away with the need for wood and will, to some extent, replace coal and oil, part of which has to be hauled for long distances. The resultant saving in railway equipment is estimated by the Moscow press at 100,000 freight cars.

The Saratov gas reservoir is said to be large enough to supply Moscow with 47½ million cu. ft. of gas a day, about five times the present supply for the city. It will be used, the report said, mainly for consumers in house heating, cooking, factory kitchens, bakeries, etc. In summer, however, when heating for houses is not needed, gas will be used for industry.

Prospecting for more gas fields for use in other parts of Russia is underway. Exploration parties are covering areas near Stalingrad, Novorossiisk, Gorky, in the Ukraine, and other places. Known gas deposits are being surveyed for prospects of further development and use.

duction is already under way in refineries on the Eastern Seaboard, Gulf Coast, Mid-Continent, and Great Lakes areas. In addition to these projects now in the course of design and construction, a large number of additional projects are under active consideration and scheduled for construction within the next 2 years.

The trend among refiners is the production of higher quality lubricating oils with increased flexibility and with maximum yields from crude at minimum costs. The installation of propane deasphalting units and efficient vacuum units will aid refiners in obtaining maximum yields of lube stocks and in affording flexibility for balancing viscosity requirements. Until substantial lubricating oil facilities are installed abroad, the large bulk of lubricating oils required for foreign markets will be produced in United States refineries. During the war years there was an extensive development of compounded lubricating oils containing a variety of additives including anti-oxidants, detergents, viscosity index improvers, foam inhibitors, and pour point depressants, most of which have been proved in service to prolong the life of aircraft and other military power units. The extensive use of additives not only facilitated the production of the required quantity of high quality lubricating oils from limited facilities but, in addition, imparted additional desirable properties to these oils unobtainable by other means. The extensive use of additives will undoubtedly continue and it is predicted that there will be a $100,000,000 annual market for these materials.

War requirements stimulated the development of many new uses for microcrystalline waxes, and during the 5-year period from 1939 to 1944 production of micro-crystalline waxes increased sixfold to approximately 120,000,000 lb. per year. These waxes played an important part in the military packaging program and it is expected that micro-crystalline wax manufacturing facilities will be expanded along with lubricating oil refining facilities during the coming years in order to accommodate a further increased market for these waxes resulting from the war development of new uses for this product. It is significant to note that older methods of refining waxes are gradually being replaced by modern solvent methods, particularly in the field of micro-crystalline waxes. The sweating method for finishing crystalline waxes is still employed to a considerable extent. For increased production this process is being supplemented by several new installations of water emulsion wax deoiling units. Among the newest developments in solvent dewaxing have been the simultaneous production of marketable waxes along with low pour lubricating oils. Commercial operation of the so-called reverse sequence solvent dewaxing will be under way shortly. There is some indication that the practice of chilling wax out of a rich oil-lean solvent solution results in the production of harder, more satisfactory crystals that contain less oil and yield a more highly refined product with lower solvent requirements. Continuous production of wax along with lubricating oils also shows an attendant saving in tankage and has some advantage from an operating standpoint.

● **Chemicals from petroleum.** The future will witness a broad and extensive development in the field of chemicals from petroleum. Although growing rapidly, this industry has already reached very substantial proportions. During 1944 approximately 3,000,000 lb. of chemical raw materials were produced from petroleum, doubling 1943 production. It is estimated that chemical, pharmaceutical, and cosmetics manufacturers plan to invest a billion dollars in expanded facilities during the next 5 years. A substantial percentage of the raw materials that will be processed in these industries will originate from petroleum. Chemical raw materials produced in large volumes from petroleum are cheap and such products as ethylene and propylene used in the manufacture of plastics, alcohols, and other synthetic organic chemicals are already in large scale production. More than 1,000,000,000 lb. of ethylene and propylene roughly in equal proportions was employed for the production of synthetic organic chemicals during 1945. Large new plants for the production of further increased quantities of these 2 raw materials are now in the stages of design and construction and will shortly be placed in operation. Ketones, alcohols, ethers, esters, glycols, chlorinated hydrocarbons, styrene, and plastics are among the many products derived from these raw materials. Other synthetic organic compounds manufactured from petroleum raw materials are useful in the production of dyes, pharmaceuticals, insecticides, textile finishes, laminates, adhesives, and paints. In fact, more than half a million of the known organic chemicals can be produced from petroleum. In addition to the above mentioned petroleum derived chemicals, 63,000,000 gal. of nitration grade and 34,000,000 gal. of aviation grade toluene were manufactured from petroleum in 1944. This was approximately three-quarters of the nation's total toluene producion. Approximately 150,000,000 lb. of dyestuffs were produced in 1944 from raw materials derived from petroleum. The plastics industry, which has already reached substantial proportions, will be expanded tremendously in the coming years. Extensive research programs have been under way for several years with the result that plastics will find utilization for almost every conceivable object including not only accessories for automobiles, boats, radios, electrical equipment, and clothing but also for railroad car tops, boat hulls, prefabricated homes, and oil field equipment. Plastics is becoming a large tonnage industry and will therefore require raw material in quantities that the petroleum industry can readily supply. Thus the plastics industry will undoubtedly be closely linked with the petroleum industry. Synthetic rubber plants built for and operated by the petroleum industry during the war were successful beyond all expectations. They played a major role in the nation's synthetic rubber program, which was so vital to the war effort. Several of the synthetic rubber plants deriving their raw materials from petroleum have achieved such low operating costs that there appears to be no doubt of their ability to maintain continued profitable operation.

● **Substitute fuels.** No discussion of the postwar petroleum refining picture would be complete without at least a mention of such subjects as liquid fuels from natural gas, shale, coal, or energy from nuclear fission. The production of gasoline from natural gas, shale, or coal is not economical today; however, the Bureau of Mines as well as industry are studying and developing these processes for future application. With regard to atomic power, the scientists and engineers familiar with this subject predict its use for power in the far future, and its development will be watched with a great deal of interest. ★ ★ ★

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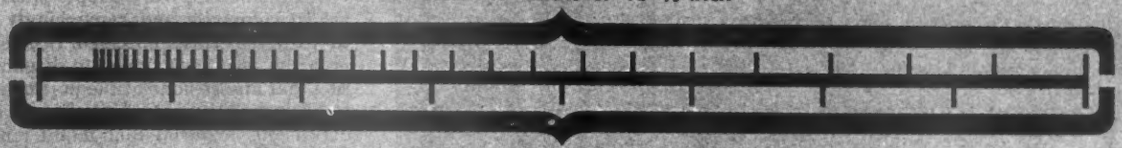

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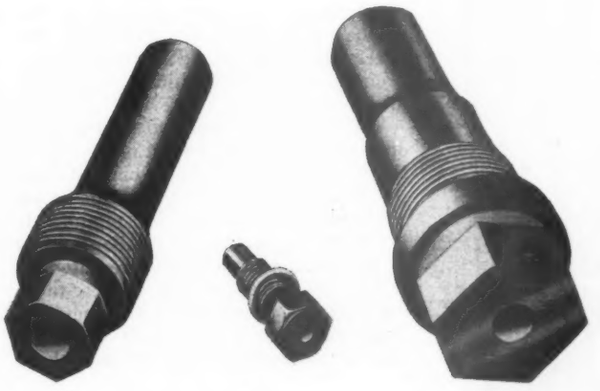


Positive bean for cage nipple | Insert for use with positive bean | Positive bean for choke body assembly

60 sizes of "X" beans up to 1/2-inch—31 sizes of "X" beans to take the place of the corresponding 8 fractional sizes from 1/64 to 1/8-inch. The obvious result of this high selectivity of orifice sizes is precise flow control. For example, to change from a 1/64" to a 2/64" bean increases the flow area by 300%, whereas changing from a UNIBOLT "X" 1 to an "X" 2 bean increases the flow area by only 10%.

Simplified flow computation—because they are gauged in increments of 10%, the proper size "X" bean can be easily determined. If, for example, a well flows approximately 100 barrels thru a given size "X" bean, the next larger or smaller size bean will result in a 10% increase or decrease, as desired.

Economical renewable inserts up to 1/8"—(see cut), 1/8" and larger orifice beans are 6" and drilled full length.

File-hard beans . . . long life—UNIBOLT "X" Beans are heat-treated to produce minimum hardness of 60 Rockwell "C"

WRITE FOR CATALOG D-46

THORNHILL-CRAVER COMPANY

HOUSTON, TEXAS

UNIBOLT
THE ONE BOLT COUPLING

MODERN FIRE PROTECTION TRAINING

By **RICHARD SNEDDON,** *Pacific Coast Editor*

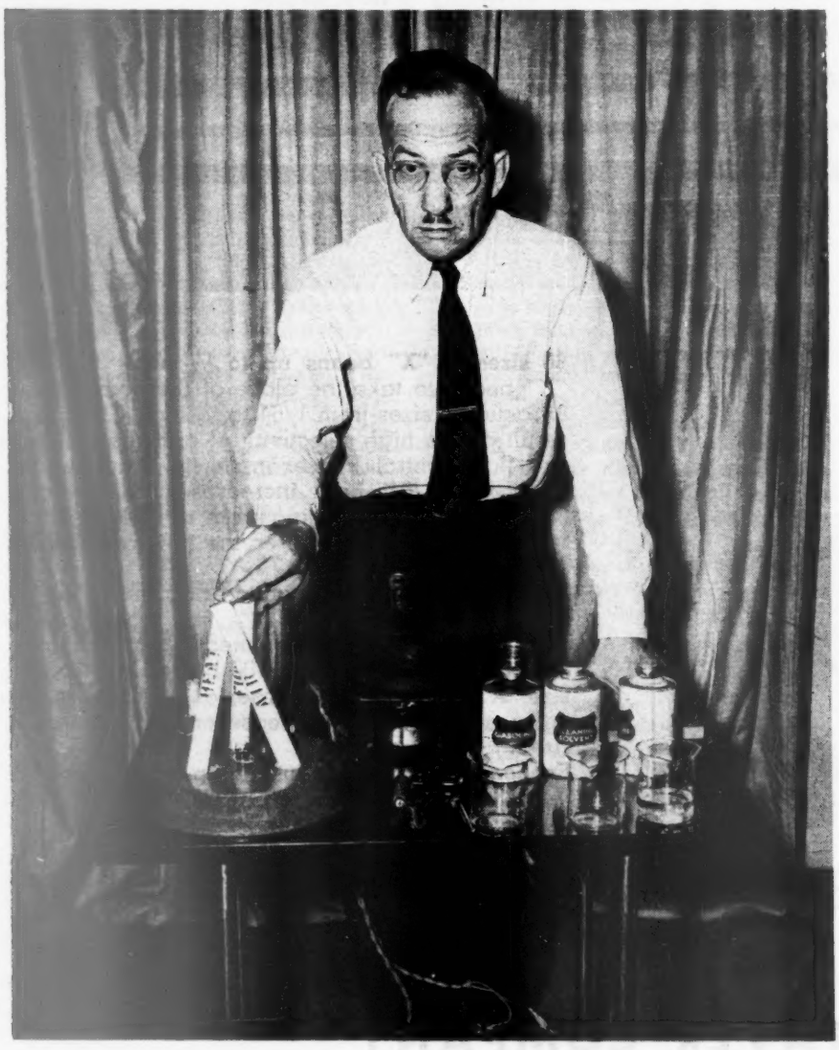
EXCLUSIVE

THE institution of an effective system of fire protection is a continuous process that, so far as the petroleum industry is concerned, must be constantly adapted and amended to satisfy changing conditions. As the various operational processes and devices are improved, and new and different hazards are introduced, revised fire prevention control and extinguishment techniques become necessary. This revision, although important, is more or less incidental. The basic considerations remain the same, and once the worker is fully acquainted with the mechanics of fire, he is in a position to understand much better the logic of protective measures, and the modus of their application. It is the effort of the petroleum industry, thus, to promote among its workers a widespread knowledge of the fundamentals of fire, and the types of fire likely to be encountered, and then to organize them in an overall protective plan. In this way, there is at all times in effect an intelligent campaign directed toward the recognition, and reduction or complete elimination, of fire hazards; at the same time, there is ready an alert, informed, and generally adequate force to control or extinguish unavoidable outbreaks.

Some concept of modern thinking and acting on this subject may be derived from a study of the comprehensive program that has been adopted, and is now being practiced, by Union Oil Company of California. This consists of preliminary instruction in the elements of fire, employing the triangle method in a unique way, to demonstrate the essentials of ignition and combustion, and to impress the important fact that absence of any of the complementary components precludes the possibility of fire. The secret of total prevention, therefore, is to keep the three contributing factors permanently separated. This, of course, is not often possible, hence the need to develop proficiency in control and extinguishment methods.

In the basic course, as presented by Union Oil Company, fire facts are brought out in a very simple way, and yet so colorfully and convincingly that they are indelibly impressed. Instruction is in the form of a table top demonstration that misses none of the pertinent details, and at the same time is free from extraneous material that might tend to diffuse the message and defeat the intent. It is a clear, well defined presentation of pertinent and inescapable facts that are fine equipment on which to found the later training. Although Union's training experts take no credit for originating the substance of this demonstration, there is no denying the fact that they have arranged the experiments in the most logical sequence, and have changed the staging and manner of presentation in a way that places the emphases exactly where they belong. The course does, therefore, accomplish in a pronounced way that which it is intended to do.

The equipment required for the demonstration is designed to fit neatly into a small case, so that it can be carried readily from place to place, and can be assembled for action in a few minutes. It is interesting, too, that the salient points of the demonstration are presented in groups of three, which makes them easier to grasp and easier to remember. Beginning with a three-point definition of fire, the lecturer then discusses three



C. H. Van Marter, Union Oil Company, with all essentials of his "fundamentals of fire" demonstration. Note air-heat-fuel triangle on the left. When all three items are plugged in an electric globe representing fire is lighted. When any one of the three is removed the light is extinguished.

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Note that the flow bean is visible—not hidden by cage nipples or other enclosures. This permits easy access to the bean when it needs replacing and saves time.

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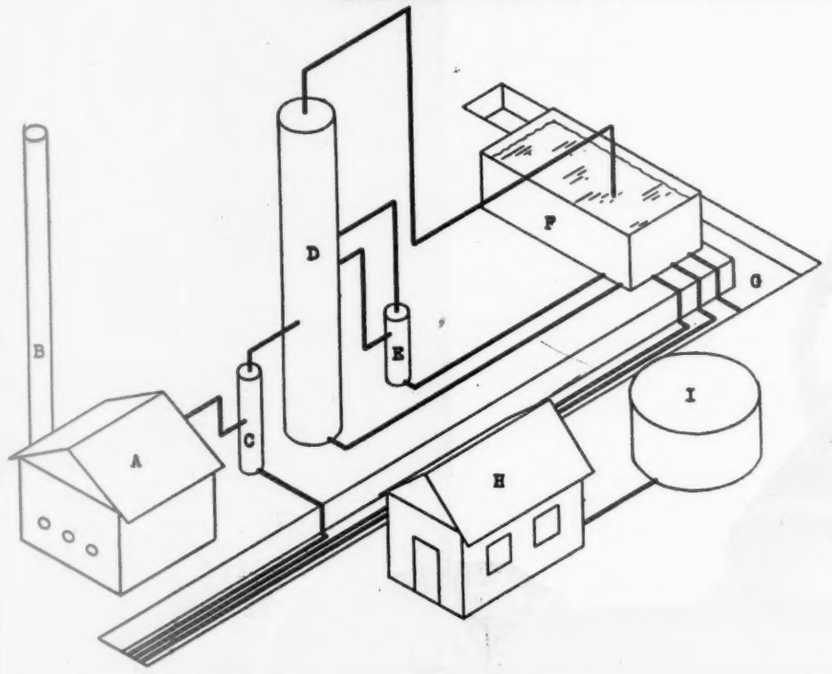
SECONDARY FIRE PROTECTION TRAINING UNIT



A—Simulated Furnace. Corrugated iron over scrap framework support. If possible, line with scrap fire brick or building brick for some protection of walls.

B—Stack.

C—Evaporator.

D—Fractionating Tower.

E—Side Cut Stripper.

F—Condenser Box.

G—Pipe Trench.

H—Combined Control House and Pump House. Contains simulated control panel, motor-pump unit and other complications.

I—Feed Tank.

rates of oxidation, three factors causing fire, three methods of prevention, three methods of extinguishment, three types of explosion, three classes of fire, etc. In subsequent training courses, primary, secondary, and brigade, this sequence of three is sustained and helps in a very appreciable way to facilitate a ready understanding of the principles expounded.

It is the belief of those in charge of this particular program, that whereas speeches, discussions, and demonstrations each have a necessary place in the total scheme of education, the development of the fullest understanding and competence in fire protection, control, and prevention can come only with actual experience in fire fighting. Conversely, of course, development of the student to that stage at which he can initiate and take part in rational action under any threatening circumstance is dependent on his ability to apply the laws, or to reason on the basis of the laws, with which he has become conversant.

In actuality, because it is fairly well conceded that safe operation is the same thing as efficient operation, Union Oil Company's fire protection training is an integral part of its general craft and operator training program. It involves the training of all workers, and the continuous education and retraining of men already experienced in fire protection techniques, including workers, supervisors, foremen, etc.

The schedule as set up provides the basic training already referred to, and then successive advanced courses in which field demonstrations are supplemented by actual experience. These begin (primary training) with instruction and practice in the proper selection and use of the portable or first-aid type of

PRIMARY TRAINING. ***Above,*** **using a No. 15 Du Gas unit on a 60-sq. ft. pit fire (light diesel fuel). This is the beginning of the attack.** ***Below,*** **subduing a pit fire with a 1-in. fog nozzle.**

L

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pumping units

The technique of combining engineering science with actual field practice has been brought to full and complete fruition in the new **LUFKIN PUMPING UNITS.**

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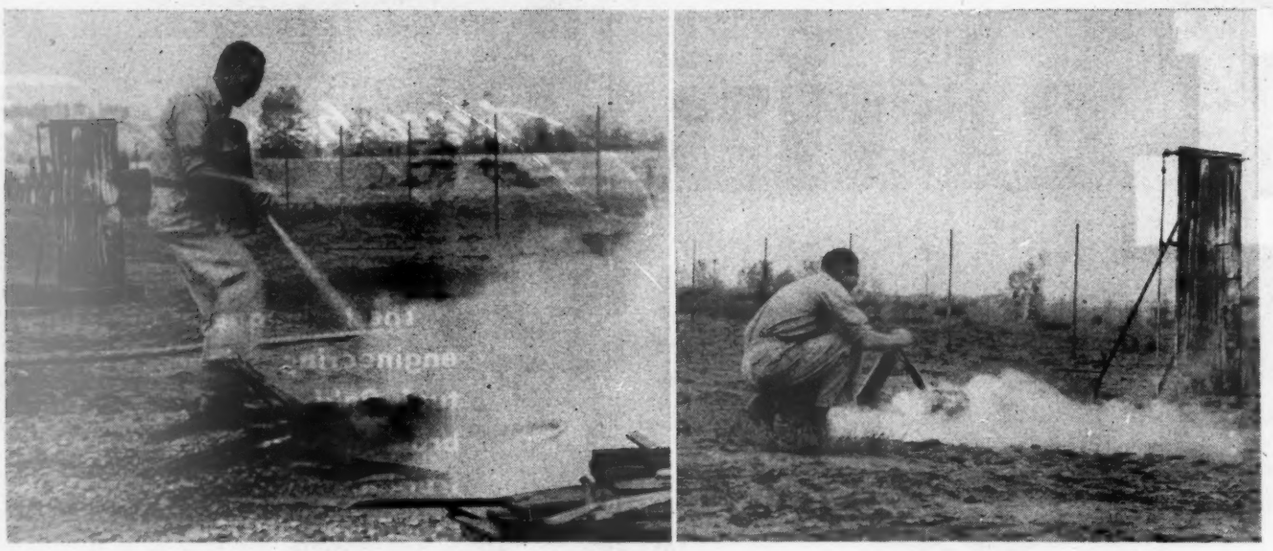

PRIMARY TRAINING. ***Left,*** **extinguishing a trash fire with portable soda-acid unit.** ***Right,*** **a simulated motor fire is smothered with CO_2 from a hand unit.**

extinguishers on various kinds of comparatively small fires. The next step, (secondary training) consists of field demonstrations and actual individual application of large portable units, water fog or spray nozzles, and dry powder foam generators, etc., on large fires. The most advanced stage, (brigade training) involves instruction and practice in the use of large scale equipment, and education in the teaming up of considerable groups of fire fighters into smooth functioning units, for the control and extinguishment of major conflagrations.

In the school, fire protection is defined as the combination of three distinct activities: (1) Fire prevention, (2) fire control, and (3) fire extinguishment. Fire preventive measures can be engineered into any industrial plant or unit, and every theoretical and mechanical precaution can be observed, yet an uninformed employe can destroy all that has been set up by one perfectly innocent gesture. It follows, then, that worker education is a vital necessity in an orderly fire prevention system.

Fire control, strange as it may seem, is sometimes preferable to extinguishment. It may under certain circumstances be desirable to permit a fire to burn itself out under controlled conditions rather than to extinguish it. It is frequently necessary to control a fire to prevent it from spreading to other flammable commodities, or from endangering adjacent facilities. The graduate student obviously should be qualified to decide such matters, as well as to take the actual steps required to bring about the desired control.

Fire extinguishment usually requires quick thinking and decisive action. The right kind of thinking should certainly be easier and faster to a man having previous experience. The courses are designed to provide this experience, to acquaint the student with every bit of essential information, and to so correlate experience and education as to enable him to analyze quickly and correctly any fire situation that may develop, and to apply the proper control or extinguishment measures.

Three general types of fire are recognized, as follows:

Class A. These are fires in ordinary combustible materials, where the quenching and cooling effects of quantities of water are of first importance. On these one should use soda-acid extinguishers, water buckets, garden hose, etc. Carbon tetrachloride is effective on small fires of this class.

Class B. Includes fires in flammable liquids, greases, etc., where blanketing or smothering effect is essential. Use foam or water fog on large fires. Use Du Gas, carbon dioxide, or carbon tetrachloride on small fires. Do not use straight streams of water on light oil fires.

Class C. These are fires in electrical equipment, where the use of a non-conducting extinguishing is recommended. Use Du Gas, carbon dioxide, or carbon tetrachloride. Water fog may be used in some cases. Soda-acid, foam or straight streams of water should not be used.

● **Primary fire training.** The course opens with a review of the basic training, and then launches into a study of extinguishers, expounding the answers to the three questions: (1) How is the extinguisher constructed, and how does it function? (2) What are the uses and limitations of the extinguisher? (3) How is the extinguisher used on the types of fire for which it is recommended? The exposition is very exten-

SODA AND ACID EXTINGUISHERS. Action is quenching and cooling. Fine for "A" fires only. Invert before using. Mixture of chemicals produces water pressure, but no chemical reaction to assist fire fighting. Stream from unit is merely carbonate water.

1 LIFT OFF WALL HOOK
2 CARRY TO FIRE IN UPRIGHT POSITION
3 INVERT AT SCENE OF FIRE
4 AIM WATER OR FOAM STREAM AT BASE OF WOOD FIRE; FLOAT FOAM ON FLAMMABLE LIQUID FIRE

Rated from 5 to 10 H. P. at Speeds from 450 to 900 R. P. M.

★ Smooth-Running

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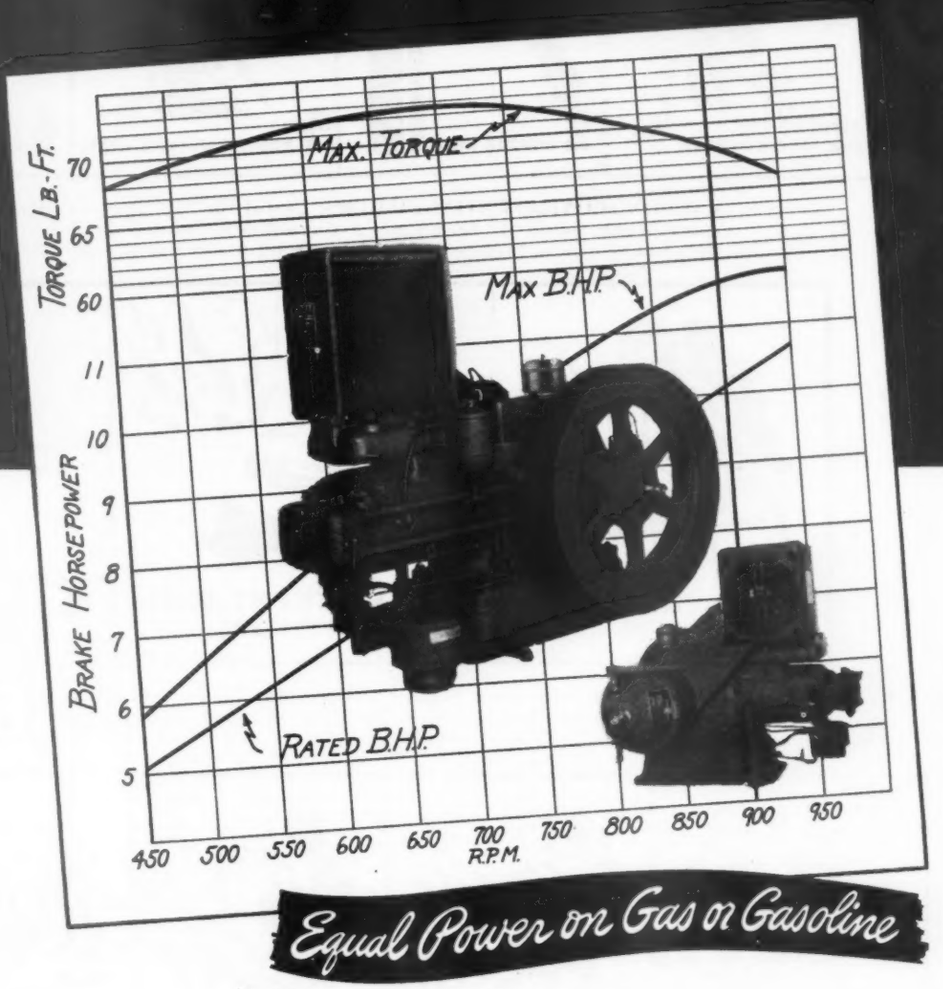

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CRANKSHAFT — Counterbalanced drop-forged crankshaft of heat-treated steel tapered for flywheel, thus eliminating split hubs.

PRECISION GROUND PISTONS are fitted with four compression rings and two oil rings. Hollow, full-floating piston pin.

REMOVABLE CYLINDER LINER of the wet type is made of chrome nickel iron and accurately honed to a mirror-like finish.

CONDENSER COOLING in a closed system maintains uniform operating temperatures at the boiling point.

THE torque and horsepower curves give you a quick picture of the wide performance range available with this heavy-duty, single-cylinder, four-cycle power unit.

Easy starting is assured by free-running roller bearings, convenient compression release, good choke valve and hot spark at hand-crank speed.

Lugging Power is provided at all horsepower ratings and speeds from 450 to 900 R.P.M.

Other Features include (a) sensitive, easy-to-regulate governor which gives instant speed control, (b) lubricating oil pump and filter, (c) mechanically operated valves and (d) all working parts in weatherproof enclosures.

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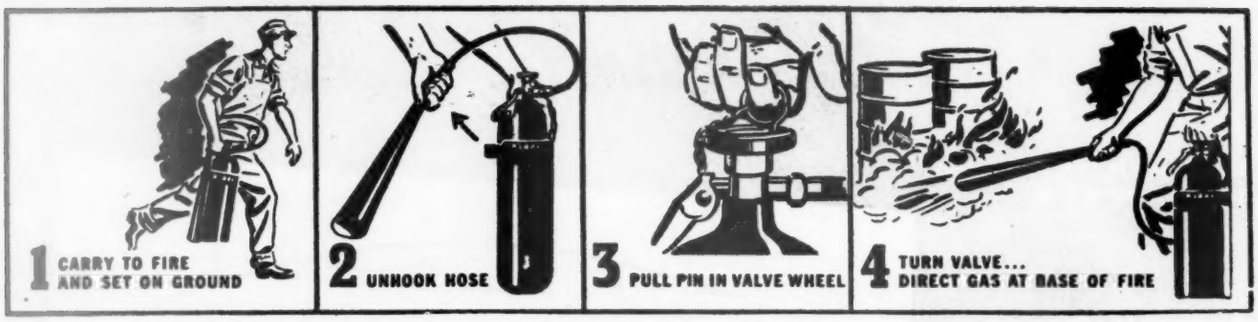


CARBON DIOXIDE EXTINGUISHERS. Useful for "B" fires, excellent for "C" but controls only small "A" fires. Carry extinguisher to fire and aim horn. Aim at base of fire. Gas stream is readily deflected in strong winds but is especially good indoors.

VAPORIZING LIQUID EXTINGUISHERS. Useful on all fires but has several faults. Carry to fire, turn handle to release catch and pump, directing stream at base of fire or on side wall of container. Fluid evaporates, forming a heavy, non-combustion gas.

1 LIFT OFF WALL HOOK
2 CARRY TO FIRE IN UPRIGHT POSITION
3 INVERT AT SCENE OF FIRE
4 FLOAT FOAM ON FLAMMABLE LIQUID FIRE BY BANKING OF SIDE WALLS OR BY SPRAYING

FOAM EXTINGUISHERS. Useful for "B" fires only. Invert to use directing stream at base of fire, against inside wall of container, or form a spray by holding finger loosely against nozzle. The foam blanket cuts off air and smothers fire.

sive, covering the known variety of pertinent hand type, or so-called "first-aid" units.

When the student has become thoroughly familiar through observation and contact with all the intimate details of construction, operation, and application of the various units, he is then given first-hand experience in their use. He is shown how to manipulate the device in each case to the best advantage, and actually controls or extinguishes fires of such character and dimension as can be taken care of properly by the small units, such as, the 2½-gal. soda-acid, 2½-gal. foam, 1-quart tetrachloride unit, the small carbon dioxide unit, and the No. 15 or 30 Du Gas.

In the primary training, the importance of speed, coupled with good sense, is emphasized, because it is conceded that the early stages of any fire are the critical time, and that fires discovered and attacked in the first five minutes of their existence can, in many instances, be subdued with the small, first-aid fire equipment. On the other hand, fires that are not discovered within this critical space are likely to be more or less disastrous, depending on circumstances and surroundings. The course is designed, therefore, to so educate the student that he is capable of making the right decision and taking the proper action with the minimum of delay.

Each topic in the curriculum is studied in great detail. The objective of the training is to provide the operator with the necessary knowledge and skills to enable him to make most effective use of the several types of extinguishers. The method employed is to break down the mechanical units into their constituent parts, determine the purpose of each, learn exactly what the extinguishment media are, how they function, and, finally, how and where to use the reassembled device to the best advantage.

● **Secondary training.** Secondary training develops a corresponding familiarity with and understanding of the wheeled units, and other equipment designed to cope with larger fires. Included in the course are studies of the soda-acid and CO_2 wheeled units, foam—40-gal. wheeled and 120-gal. tumble bug, Du Gas No. 150 and 350, 1-in. fixed fog

nozzle, 1½-in. handlines and foam generator carts. These are virtually dissected, examined, and reassembled by the students themselves, after which sufficient time is spent in actual practice under conditions very closely simulating reality to develop expertness, or at least facility, in their use. It is perhaps not quite correct to speak of simulated reality in this connection, for there is no disputing the reality of the fires. The only difference between them and the usual type is that they are purposely started.

As this particular part of the training incorporates education in the nature and handling of the devices most commonly required in oil plants, the course is considered especially important. It involves the use of fog equipment, which in recent years has been recognized as an invaluable aid in refinery protection and other equally important aspects of fire control and extinguishment. The fine dispersion of water created by the fog nozzle has given the industry one of its most effective fire control media. The spray has a three-point action, as follows: (1) It reduces the oxygen content of the air-vapor mixture, thus partly smothering the fire; (2) in the case of heavy oils it tends to reduce vapor concentration of the air-vapor mixture below the flammable limit, and (3) it is an excellent coolant. The heat required for vaporization of the fine droplets comprising the fog is literally stolen from the fire, and even in those cases where it is incapable of extinguishing the fire, it is effective for holding it in check.

Fog, indeed, is practically limitless in its applications in the fire fighting field. It can perform many useful functions not possible with any other known agent. For example, when hot vapors are escaping from a line, they may be cooled not only below the ignition point with fog, but even below the flash point. If already ignited, the fire can usually be extinguished with fog. Fog nozzles are also used with success when light vapors are escaping from a line, and before they have ignited. The technique here is tricky, and should be directed by some one informed and responsible. This is one of the most dangerous situations that can develop on an oil property. The process requires the dual operation of ignition and quenching and conditions must be right before it can be attempted. An escaping light vapor that has already ignited can be extinguished with fog almost as in the case of a heavy vapor leak.

Among the valuable uses of fog are driving back fire for the protection of persons who must work in the fire area, and similarly for the protection of equipment. When a shut-off valve is enveloped in flames, or entry to a building is barred for the same reason, fog is usually capable of pushing the fire back and enabling the fighters to carry out their maneuvers. It is also used successfully in combination with foam, where a larger volume is required and the smaller nozzles are inadequate. In the secondary training, the manipulation of these fog nozzles and fog-foam cabinets is an important part of the instruction. The course involves every conceivable type of large petroleum fire, and practice in the methods by which they are controlled or subdued.

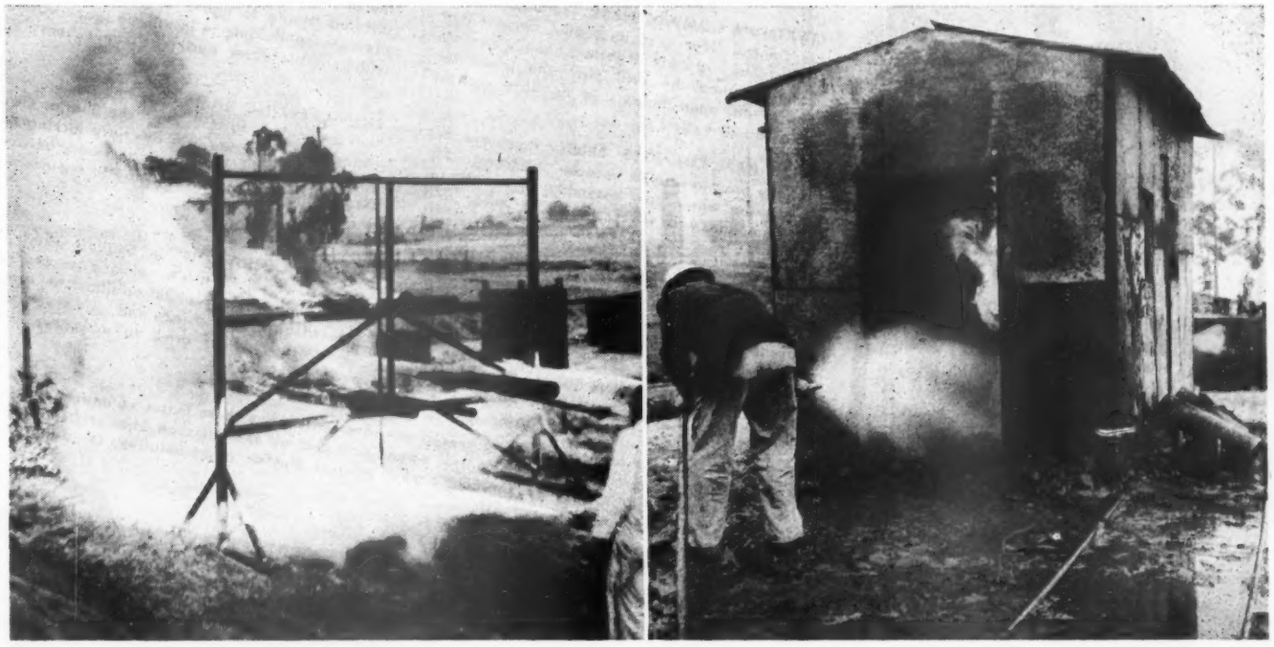
In order as nearly as possible to duplicate actual fire conditions, Union Oil Company has constructed a secondary fire protection training station from junk equipment, which is equipped to provide all the essentials for a wide variety of petroleum fires. This unit has a fractionating tower with vapor lines, a simulated condenser box, control and pump house complete with pumps, a pipe trench, and several other pieces of full-scale equipment. This arrangement provides an opportunity not only for the practical training of workers under conditions that very closely approach the real thing—a sizeable fire of each known type, in actual equipment—but also for the carrying on of fire protection research and investigation. It will be used, too, as a proving ground for new fire control devices and extinguishment agents, and should contribute much to the effectiveness of training and the improvement of protection techniques.

● **Brigade training.** This is largely a course in the business of organization and cooperative planning. It teaches the qualified operators how to team together under competent leadership to strategically locate, economically maintain, and

Pure heptane available

Frank Phillips, chairman, and K. S. Adams, president, of Phillips Petroleum Company, have announced that normal heptane of more than 99 per cent purity is now available in tank car or drum quantities. This extremely high purity normal heptane has been separated by the Phillips superfractionation process from the 16 naphthenes, iso-heptanes, and other compounds boiling in the narrow range that occurs in petroleum and natural gasoline.

SECONDARY FIRE TRAINING. ***Left,*** **burning gasoline cascading through 10-ft. by 12-ft. by 15-ft. pipe rack to resemble complicated manifold fire. Attack is made with two No. 30 Du Gas units.** ***Right,*** **house fire attacked with No. 22 fog nozzle. Bottom fire has been extinguished.**



Watch THESE SHAFFER RAMS CLOSE

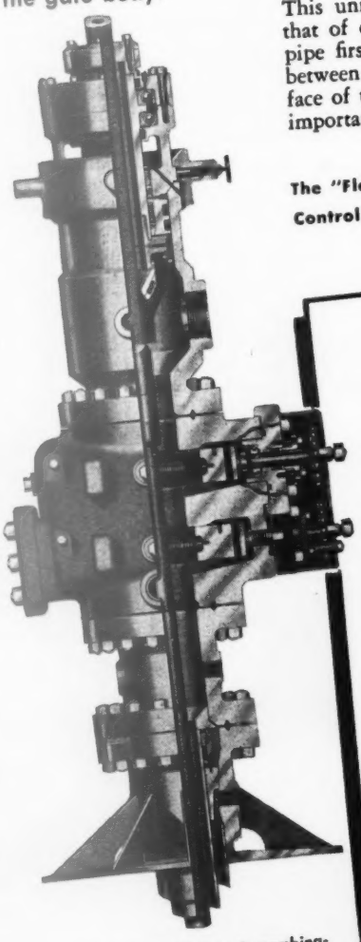
See how Shaffer's "Floating" Ram is engineered for friction-free closing and tighter pack-off!

ONE OF THE MANY advanced features engineered into Shaffer Gates is the Shaffer "Floating" Ram—a ram that utilizes rubber "flow" to assure positive, complete and unusually friction-free closing of Shaffer Cellar Control Gates against even the highest well pressures. As outlined in the accompanying illustrations, you will note that in the Shaffer Gate the rams seal off around the pipe *first*. Then—and only then—is the one-piece ram rubber squeezed backward and upward to form a tight seal between the ram and the upper inside face of the gate body.

This unique Shaffer feature—that of closing off around the pipe first and *then* sealing off between the ram and the inside face of the gate—is one of the important reasons why Shaffer Gates give such effective pack-off in any emergency. It insures two important advantages...

1. That there is no pack-off—therefore no friction or wear—between the rams and gate body until *after* the rams are completely closed and tightly packed around the pipe. Rams not having this exclusive Shaffer feature develop friction of the packing when opening and closing the gate. This friction could prevent the rams from fully closing, thus permitting leakage around the pipe and jeopardizing the safety of the well. But such risks are eliminated with the friction-free action of Shaffer "Floating" Rams!

2. By utilizing "squeeze" against the one-piece ram rubber to seal off against the inside face of the gate body, not only is a more complete and positive closing assured, but also quicker and easier *opening* of the gate when the emergency is over. As mechanical force against the rams is released, the first action that occurs is for the rubber to contract to its original shape. Thus it *automatically* pulls away from the gate body to eliminate any friction or drag as the rams are opened. This means smooth and easy opening!



The Shaffer Double Gate in combination with the Shaffer Combination Rotating Blow-Out Preventer and Stripper (top) and Shaffer Base.

The "Floating" Ram is another of the many engineering advancements that make Shaffer Cellar Control Gates the safest and most efficient pressure control equipment you can install on your wells!

Features Like These Make Shaffer Control Gates the Outstanding Choice for Modern Well Control!

MAXIMUM COMPACTNESS The Shaffer Double Control Gate is so unusually compact that it combines two control gates... the upper for closing around the drill pipe—the lower for closing off open hole... in as little vertical space as 23 inches!

EASY RAM CHANGES Shaffer Rams are unusually easy to change because you can quickly reach the whole ram assembly by simply removing one end cover. Reduces labor and simplifies ram changeovers!

POSITIVE MECHANICAL DRIVE Uncertainties are reduced to a minimum in Shaffer Gates because the rams are opened and closed by positive direct mechanical drive that is quick, simple and foolproof!

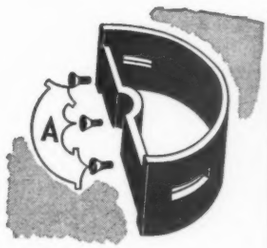
SIMPLE INSTALLATION Shaffer Control Gates are extremely easy to install. Simply install them on the landing head or mud cross, connect the driving means and the job's done. No complicated piping to figure out, no time-wasting pressure manifolding to install, no space wasted with multiple valve and pipe connections!

NON-CREEPING RAMS Only one quick operation is required to both close the Shaffer Gate—and keep it closed. No auxiliary locking devices or extra operations are necessary because Shaffer Rams automatically stay in the position they are set.

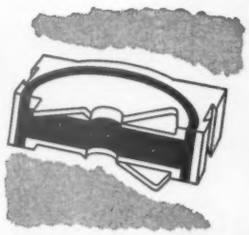
POWER OPERATION In Shaffer Gates you have a choice of steam, electric or even hydraulic power drives (in addition to manual operation) for closing and opening gates. There's a type of drive to meet every well requirement!

These and other Shaffer-engineered advancements make these Gates so unusually efficient for modern well control operations. Get all the facts on Shaffer Cellar Control Equipment by contacting your nearest Shaffer representative. Or write direct for complete details!

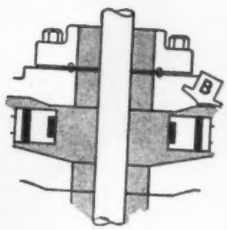
THIS IS HOW THE SHAFFER "FLOATING" RAM WORKS



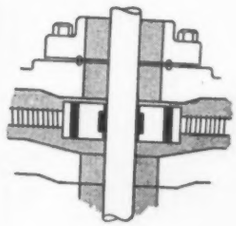
1 This is the Shaffer Ram Rubber. Note that it is *one continuous* piece of rubber that completely encircles the ram block and is fastened to the ram block with screws (A). Construction is similar on both types for closing off open hole and for closing off around the pipe.



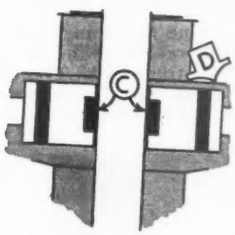
2 This is the Shaffer Ram Rubber assembled on the Ram Block and in the Ram Block Holder. Note how the face of the rubber is in position to seal against the pipe, while the rubber "floats" with the Ram Block in the Ram Block Holder and is permitted a slight rotary movement to allow positive alignment of the abutting faces for a perfect seal.



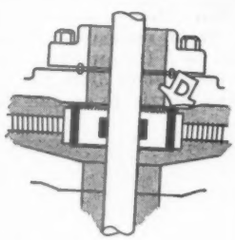
3 Now watch this Shaffer Ram as it closes. Note that the inside of the gate (B) is recessed so that, in the open position, no portion of the ram rubber contacts it. This insures easy, friction-free closing at all times.



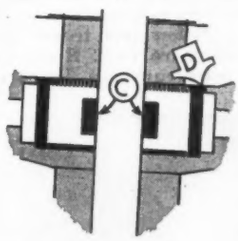
4 As the rams continue their closing action the ram rubbers contact the circumference of the pipe first, squeezing tighter and tighter against this surface as closing pressure is applied to the rams.



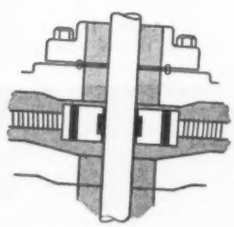
5 It is important to note that the rubber completely seals off around the circumference of the pipe and against the opposite ram faces (C) *before* any sealing action has taken place against the inside face of the gate body (D).



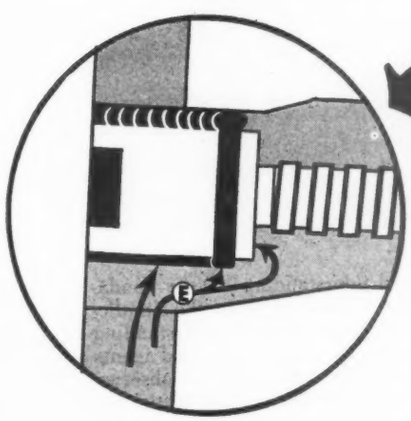
6 Now as the rams close tighter the rubber begins to "flow" back around the Ram Blocks and squeezes up between Block and Holder to completely seal off against the inside face of the gate body (D).



7 With the rams now completely closed, the pipe is sealed off at (C) and the opening between the rams and gate body is sealed off at (D), thus completely closing the well against pressure leakage!



8 When the emergency is over and the gate is opened, the ram rubbers automatically contract away from the gate body, thus eliminating drag and friction as the gate is opened. Operation is positive and friction-free.



AN ADDITIONAL SHAFFER FEATURE!

Not only is the closing action of the Shaffer Gate engineered so that the rubber "flow" assists in sealing the gate, but the Shaffer Gate has always been engineered to utilize well pressure to assist the sealing action. Note that the rams seal off against the upper inside face of the gate only, leaving the lower side (E) open to the well. Thus, with the ram sealed against the circumference of the pipe the well pressure is free to flow up *behind* and *below* the rams, closing them even tighter as well pressures increase. This is another of Shaffer's many unique engineered advantages!

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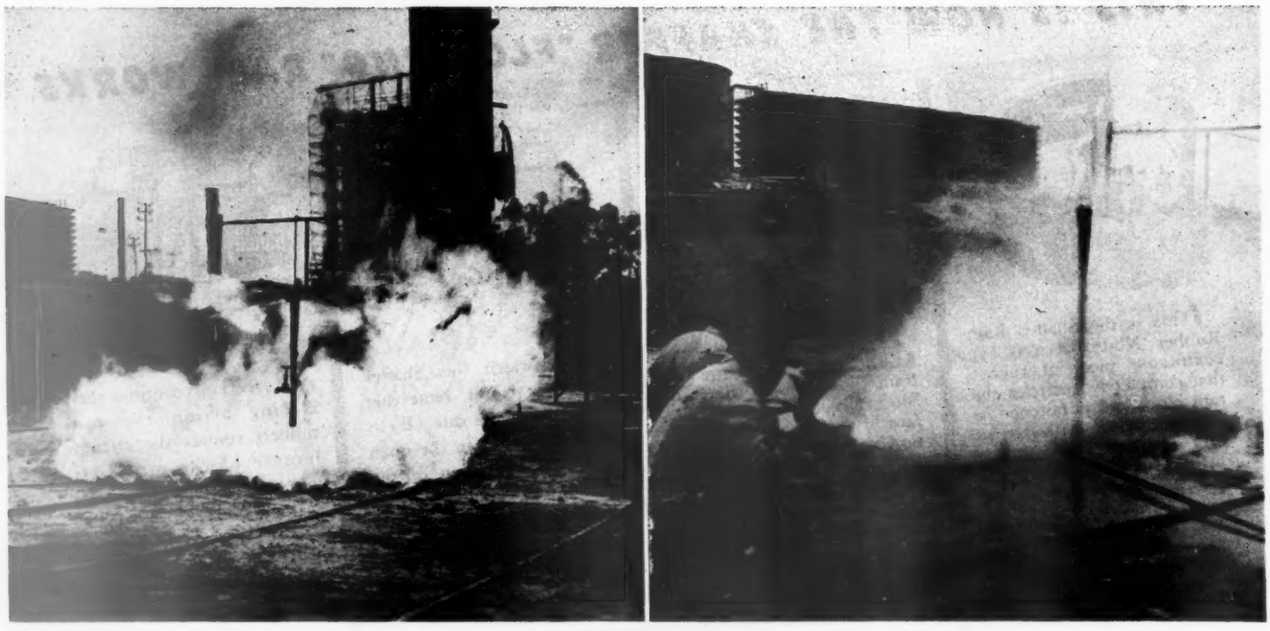
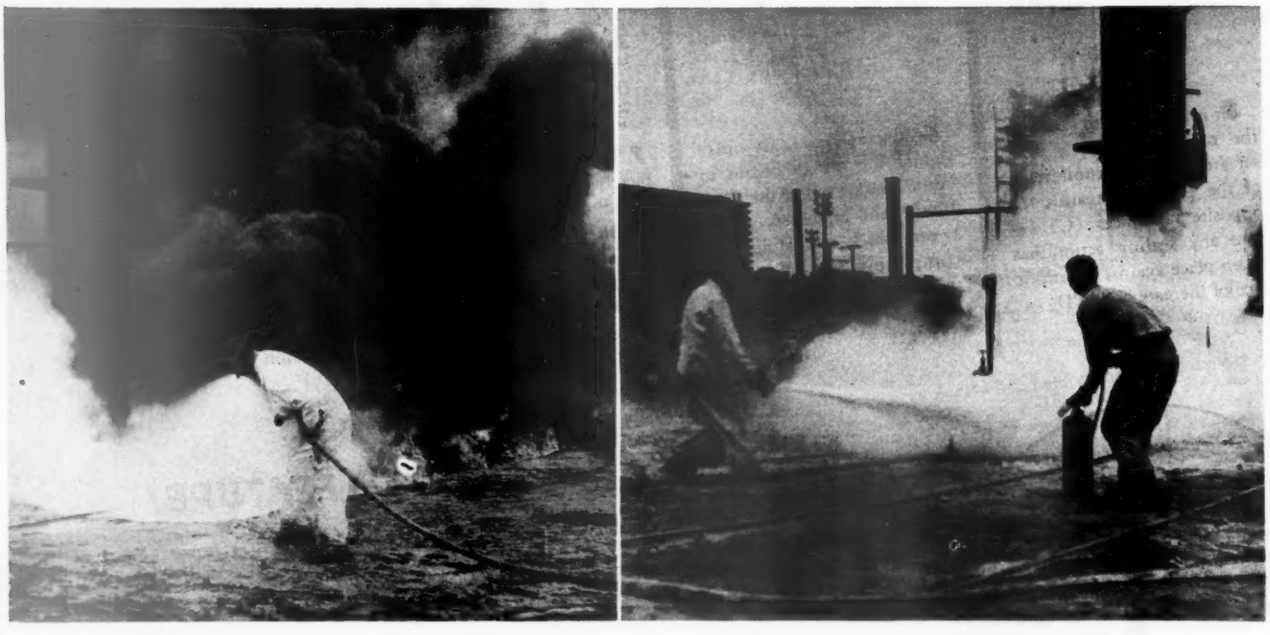
See the Shaffer section—pages 2687 to 2730—in your Composite Catalog!



SECONDARY FIRE TRAINING. Liquefied petroleum gas fire: *Above, left*, the problem is to subdue the flames sufficiently or push them back so that fighters can reach control valve. *Right*, operators are just ready to reach for the valve after covering flames with fog nozzles. *Below, left*, trench fire, 30 ft. by 5 ft., attacked with one N-22 fog nozzle. Trench is filled with pipe. Diesel and gasoline are fuel. *Right*, a scene taken soon after the one just above, the fire fighters are knocking down the liquefied petroleum gas jet fire with fog nozzle to enable fighters to get to shut-off valve.



efficiently use all types of fire protection units, in the types of fires for which they are recommended. Its purpose is to extend application of the principles and functions with which the advanced student has already become familiar, so that a cooperative or brigade plan can be implemented for the overall protection of large vulnerable areas and properties.

The students are taught when, where and how to marshal their respective facilities under all predictable emergencies, and how to work effectively together in the event of a major outbreak. This is the last stage in fire protection. It is designed to meet those situations in which every person and every facility is required either to go into action, or to stand in readiness. It actually teaches the advanced student how to dispose his forces and equipment to do the best cooperative job of fire fighting, with any type of fire, of any size, and under any set of conditions.

The entire training program from basic to brigade is tremendously worthwhile. It embraces all phases of fire control and extinguishment, and is as complete and comprehensive as it could well be. It appears to be premised on the belief that two of the most important essentials in the building of an adequate fire fighting force are understanding and practice. Understanding of the fundamentals of fire is assured by the simplicity of the presentation. Understanding of the functions of equipment and agents is derived by actual study and observation. Familiarity in the use of the various units is turned to eventual confidence with continued experience under widely varied conditions.

The value of such training is inestimable! It dispels fear of fire and develops that sense of mastery that is necessary to clear, fast thinking and the institution of logical preventive and control measures. It saves the petroleum industry incalculable loss to one of its most dangerous enemies—fire. ★★★

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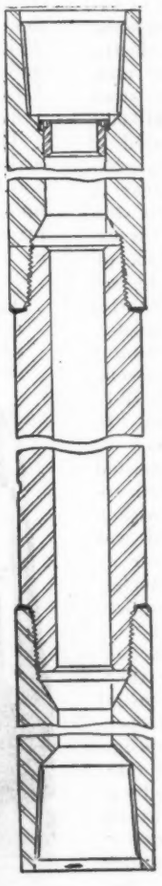
Starting 15 years ago with the Syfo Inclinometer and the Surwel Gyroscopic Clinograph, the Sperry-Sun Well Surveying Company has steadily devised new instruments and services to aid the oil operator in the economical quest for oil. The majority of these developments are the result of Sperry-Sun's practical experience and knowledge of the problems confronting drillers. Such services as the **M-M-O Bottom Hole Orientation** and the **K-K Whipstock and Retrieving Sub** have won the praise and gratitude of oil men everywhere.

Now, following the development of our so popular E-C Inclinometer, comes this newest product.

THE S-S NON-MAGNETIC DRILL COLLAR

A great saving of rig time, more accurate records and less hazardous operation are effected by employing the S-S Drill Collar. It is inserted immediately above the drill bit, and is made with proper seating arrangement to center the directional single shot surveying instrument.

Any operator will recognize its particular advantages when used in directional controlled drilling. The statement that it is made of "K" Monel metal is sufficient evidence of its strength and resistance to wear. Made in standard sizes. Available on a rental or outright sales basis.



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INDEPENDENT TURBO-ELECTRIC ROTARY DRIVE FOR STEAM RIG

CARL H. ECKEL, *Electrical Engineer,* Humble Oil and Refining Company
and **K. MARSHALL FAGIN,** *Field Editor*

Application of steam turbine electric power to the rotary table permits the drilling engines to shutdown.

IN the endless effort to design rotary drilling rigs that can sink oil wells faster, straighter, easier, and with lower maintenance costs per foot, the Humble Oil and Refining Company has been experimenting for several years with independent turbo-electric rotary drives using direct current on two or three of their steam drilling rigs.

EXCLUSIVE

The first installation of this kind on a Humble steam rig was made in 1944 on rig 188 at Halls Bayou in Brazoria County, Texas, where the company's Houston Farms Development Company well No. B-3 was drilled from 6,619 to 12,587 ft. The second well drilled with this first turbo-electric rotary drive was the Houston Farms Development Company well No. 4 at Rattlesnake Mound to a depth of 11,502 ft.

The first installation consisted of two assemblies, a skid-mounted turbogenerator unit and a skid-mounted electric motor-driven rotary table. These units were assembled from warehouse stock with an estimated book value of $18,000. The turbogenerator unit consisted of a 250-hp. turbine driving a 150-hp. electric motor through a reduction gear. A 20-hp. motor served as a constant voltage generator supplying power for excitation of the rotary motor and the pilot exciter and for operating the blower motor. A double Ward-Leonard control system was used with a small rheostat, and a 5-kw. rig lighting turbogenerator set acted as a pilot exciter. The assembly was mounted on a 10-in. skid, 18-ft. long, and 3½-ft. wide, was about 7-ft. high, and weighed about 22,000 lb.

The rotary drive assembly consisted of a 27½-in., 3.58 to 1 ratio, oil-bath rotary mounted on a 10-in. skid. with a 150-hp. driving motor. The skid was 19-ft. long and 4-ft. wide, but later its length was reduced to prevent interference with the coring unit. The complete assembly weighed about 22,000 lb.

The speed of the rotary table was controlled by the driller turning the rheostat, which was connected to the usual steam throttle valve rod. The only operating difficulty resulting from the design of the rheostat was the continued rotation of the rotary table when the rod was in the stop position. This was the result of residual magnetism in the generator. A touch-sight stop position was installed in the rheostat and a contact made that nullified the effect of residual magnetism by operating a magnetic contactor in the main circuit.

A larger independent turbo-electric rotary drive was installed on rig No. 173, which is shown in the accompanying illustrations as it was being used to drill a 7500-ft. Edwards lime well in the Imogene field of Atascosa County, Texas.

The turbogenerator unit consists of a 450-hp. turbine driving a 250-kw. 395-v. generator through a reduction gear. A 15-kw. 125-v. constant voltage generator and a 3-kw. 125-v. exciter are driven by V-belts and mounted above the main generator.

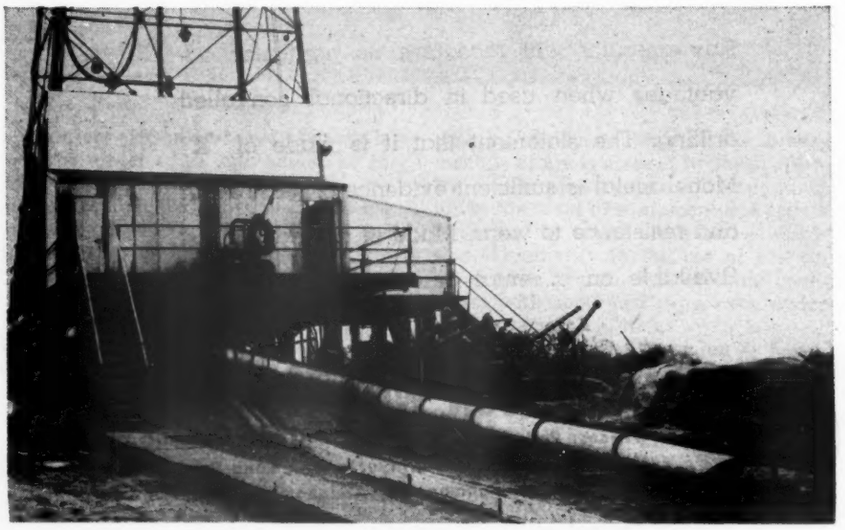
The turbine is a single-stage mechanical drive designed to operate on 300 to 350 lb. saturated steam and develop 450 hp. at 5000 r.p.m. with 3 to 5-lb. back pressure. The turbine is direct-connected by a flexible coupling to the 5000/900-r.p.m. single reduction gear. The gear is equipped with an oil pump and water-cooled heat exchanger for cooling the oil that is used to lubricate the turbine bearings, gear bearings, and gears.

The main generator is direct-connected to the reduction gear by a flexible coupling. It supplies power for the electric motor that drives the rotary table, and is controlled by the driller through a rheostat in series with the pilot exciter field, so the output can be varied to change the speed and torque of the motor. It has ball bearings and two separate fields, one for self excitation and one 115-v. separately excited field.

The 15-kw. top-mounted constant voltage generator is designed to operate at 1750 r.p.m. It supplies power to the blower motor, the rotary drilling motor field, and the control circuit. It is direct-connected by a flexible coupling to the 3-kw. exciter for the main generator field. This exciter has a separately excited field that is connected in series with the control rheostat and a series field that is fed by the line current from the main generator.

The rotary drilling motor is a mill type motor that can be operated with an output of 330 hp. It is rated at 250 hp. at 750 r.p.m. with 395 v. It has a separately excited field and the voltage is directly

Air for cooling the electric rotary motor is obtained through the sheet metal intake pipe by a blower motor mounted in the engine house substructure. Electricity is transmitted from the turbo-electric generator to the motor by insulated cables that are laid in the board trough to the right of the walkway.



the short life of

SMITH NO. 8

Smith No. 8 was cored in sand from 8000 to 8020 feet. The sand had an oil odor and on the strength of the show in the cores, pipe was set and the well completed.

The well was produced for a short time and the oil rate dropped to 10 barrels per day . . . not enough to be economically produced.

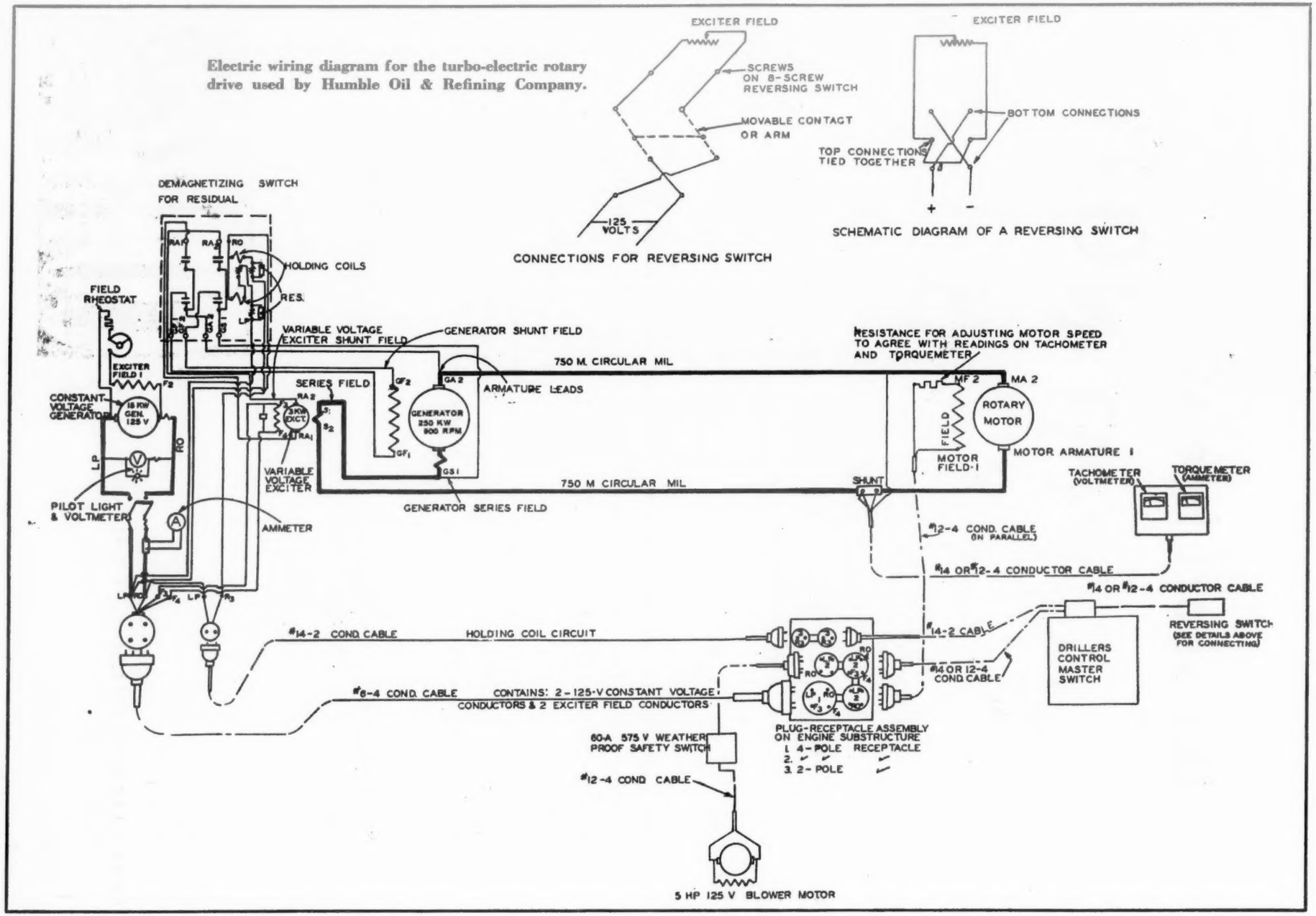
Later Core Laboratories, Inc. made an analysis of the cores from Smith No. 8 and found that the permeability *of the sand was low.

Had Core Lab been on Smith No. 8 to give a derrick floor analysis as cores were taken, the low productivity of the well would have been indicated BEFORE pipe was set.

**Permeability* is a physical characteristic of a formation, the measurement of which is an index to the rate of flow of oil or gas through the formation.

CORE LABORATORIES, INC. ● DALLAS 5, TEXAS

CORE LAB



Electric wiring diagram for the turbo-electric rotary drive used by Humble Oil & Refining Company.

over the famous Ashley Planes

AMERICAN EXCELLAY PREFORMED TIGER BRAND Wire Rope sets records for top performance over 100 year period

WILKES-BARRE in the heart of the Anthracite field is three miles from Ashley, Pa., where the Ashley Planes are located. From Ashley to the mountain top it is 1,000 feet up. The grade of the famous Ashley Planes is such that a locomotive cannot negotiate it economically. The alternate route around the mountain is 12.41 winding miles of heavy grade over which a locomotive can haul a small tonnage train at slow speed. With brilliant foresight the engineers who planned the Ashley Planes 100 years ago, chose to do it the hard way. They proposed to haul freight cars up Solomon's Gap, on three inclined planes—*by wire rope.*

As revolutionary as this project must have been in 1843, the remarkable fact is that repeated tests prove it to be more economical than the longer route, even today. Under twenty-four hour operation, hauling an average of one million tons of coal, oil and mixed freight per month—this cable-hauled railroad equipped with about 100 tons of wire rope reduces transportation costs very materially.

Best visualized by the profile reproduced at left, the Ashley Planes, now operated by the Central Railroad of New Jersey, consist of three inclines of 5.7%, 14.65%, and 9.28% grade respectively. The total rise is 1,035.9 ft. up which 35 to 45 cars are hauled hourly at from 12 to 30 mph.

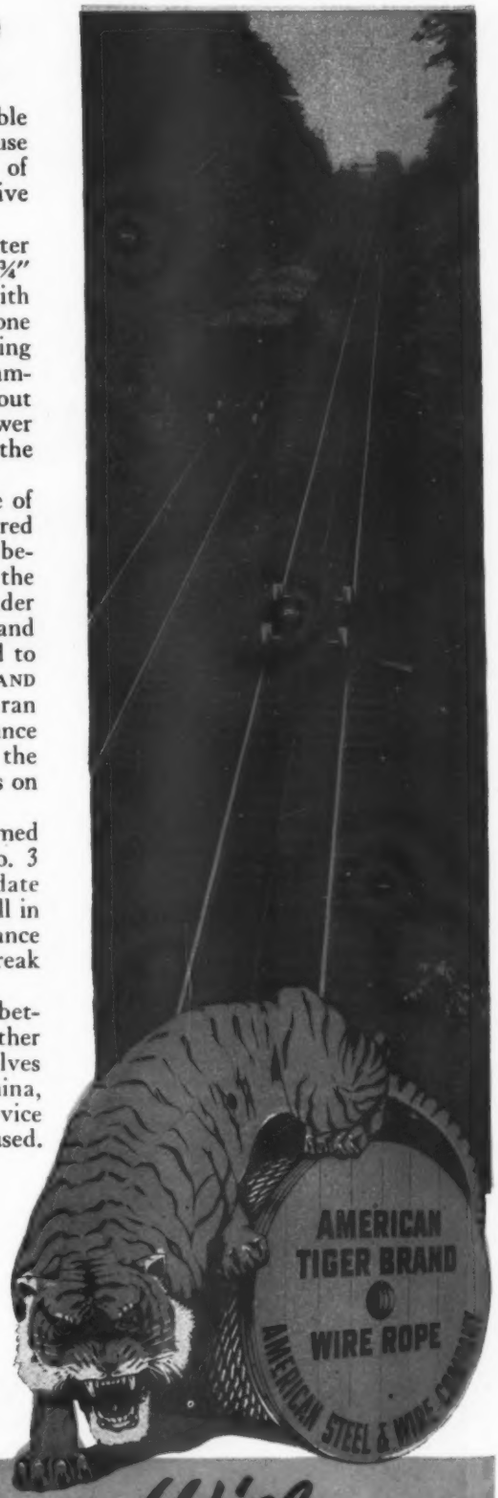
Each plane is a self-contained unit. It consists of a double track (with a truck pit at the foot of each track), and is equipped with its own hauling cable and two cable trucks or "barneys". A power house with hoisting engine at the head of each plane furnishes the motive power.

The hauling cable (2½" diameter on the top and bottom planes, 2¾" diameter on the middle plane with the heaviest grade) passes from one barney up the plane over supporting pulleys, then around 24-ft. diameter twin traction drums, then out through the bottom of the power house and back to the barney on the parallel track.

Close check is kept on the life of these hauling cables, and is measured in terms of tonnage hauled. We believe it significant that during the years when the planes were under full wartime capacity operation, and the equipment was being worked to the limit, American TIGER BRAND Excellay Preformed Wire Rope ran up the highest tonnage performance ever recorded! 19,804,642 tons on the No. 2 plane; and 27,972,495 tons on the No. 3 plane.

TIGER BRAND Excellay Preformed Wire Rope installed on the No. 3 plane in November 1943 has to date hauled 27,972,495 tons and is still in excellent condition. The performance of these ropes continues to break previous records.

These figures — substantially better than the former best with other wire rope used—speak for themselves as proof of the superior stamina, greater ruggedness and better service TIGER BRAND delivers, wherever used.



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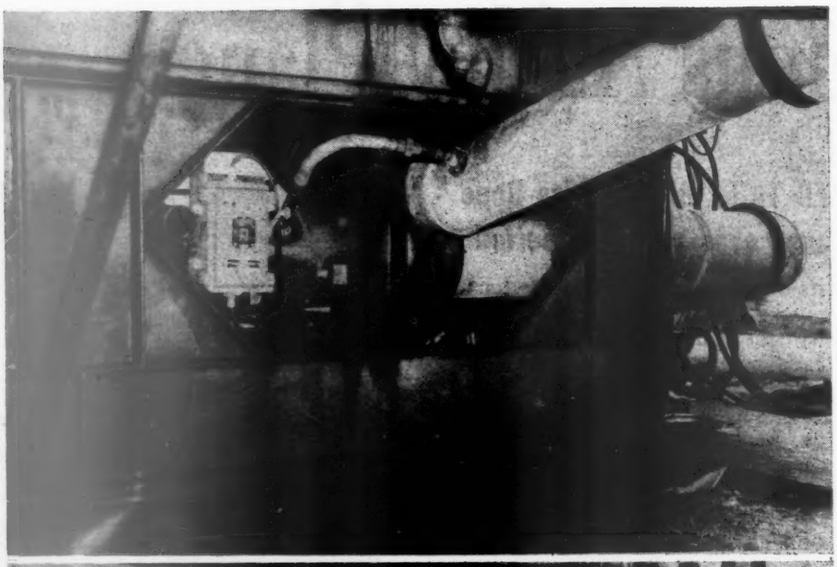
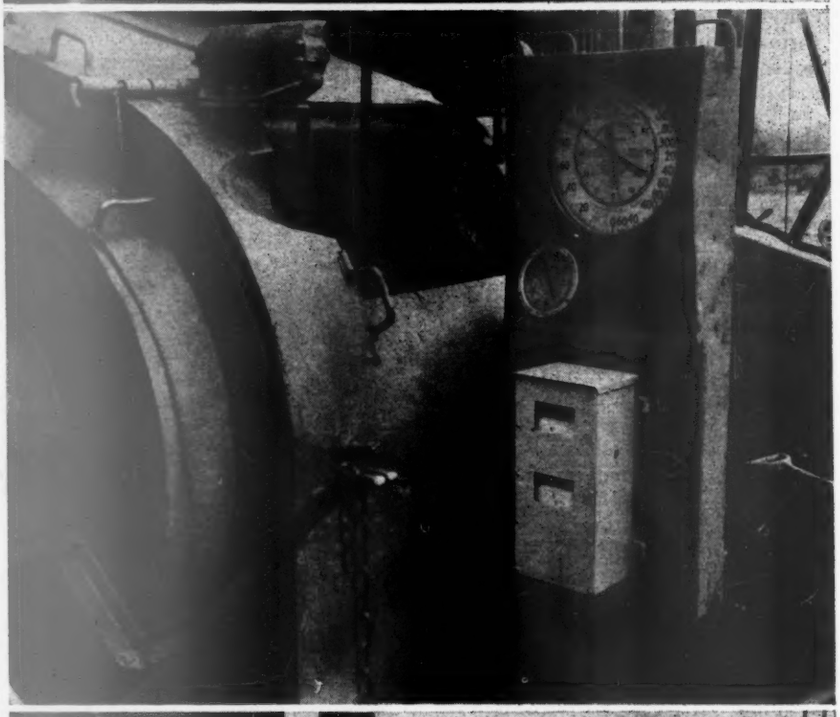
San Francisco
Tennessee Coal, Iron & Railroad Company, Birmingham, *Southern Distributors*
United States Steel Export Company, New York
UNITED STATES STEEL

USS AMERICAN TIGER BRAND WIRE ROPE UNITED STATES STEEL

Excellay Preformed

U·S·S AMERICAN
TIGER BRAND *Wire Rope*





proportional to the r.p.m. and the amount of current is directly proportional to the torque. Thus, a voltmeter can be calibrated to indicate directly the r.p.m. of the rotary table, and an ammeter can be calibrated to indicate directly the torque applied to the drill pipe by the rotary table. Instruments calibrated in this manner are shown in a sheet metal case below the weight indicator in one of the accompanying illustrations.

The rotary drilling motor is directly-connected to the rotary table by a special flexible coupling that contains 6 rubber balls 3½-in. in diameter. A regular rotary sprocket has been attached to the rotary table side of the coupling, and the motor may be quickly disconnected from the table by removing a cover plate and taking out the rubber balls. Then the rotary can be driven by a chain from the drawworks in the conventional manner in case something should happen to the turbo-electric system while a well is being drilled.

A 5-hp. 1750-r.p.m. motor is direct-connected to a fully-housed rotary fan type of blower that supplies air to cool the rotary drilling motor. These are mounted permanently in the engine house substructure. The air for cooling the motor is obtained through a sheet metal duct that extends about half way to the boilers. This reduces the possibility of an explosive atmosphere being ignited by electric sparks in the rotary motor.

Inability to stop the rotary motor completely with the control in the off position due to generator residual magnetism was overcome by the installation of a reversing switch. Then, as soon as the control was moved from the off position, the main generator field would become connected to the 3-kw. exciter, and, when the control was moved back to the off position, this switch would disconnect the 3-kw. exciter and would immediately connect a voltage from the main line of the generator in a reverse direction. This would immediately reduce the field of the generator to zero, and would leave

Top: **Air to cool the electric rotary motor is supplied by a rotary fan type blower driven by a 5-hp. 1750-r.p.m. motor mounted in the engine house substructure. A small amount of air from the blower is by-passed through the blower motor for cooling purposes.**

Center: **The speed and torque applied to the rotary table is indicated directly by the hands of the two instruments contained in the sheet metal box below the drilling weight indicator in plain view of the driller.**

Bottom: **The rotary table is direct-connected to the rotary motor, which is protected by a heavy sheet metal cover. The regular rotary chain guard is ready for use in case the chain drive from the drawworks is needed. The change can be made quickly by disconnecting coupling.**

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2 Two-piece neoprene packing seals pressures more effectively and lasts longer.

3 5-pitch V threads, for pull-down of packing, are plated to prevent galling.

4 Long forged steel slips minimize pinching or cutting of tubing.

5 Continuous ring of hydraulic packing means no spaces to leak.

6 Forged steel stripper adapter.

7 Neoprene Stripper Rubber . . . durable, oil-resistant, neoprene stripper.

8 Forged steel body . . . no porosity, greater strength. 4500 lbs. test.

9 Full opening permits passing tools, packers and acid guns without removing head from well.

10 Easily adaptable to pumping, flowing or flowing. All parts from 4½" to 7" are interchangeable.

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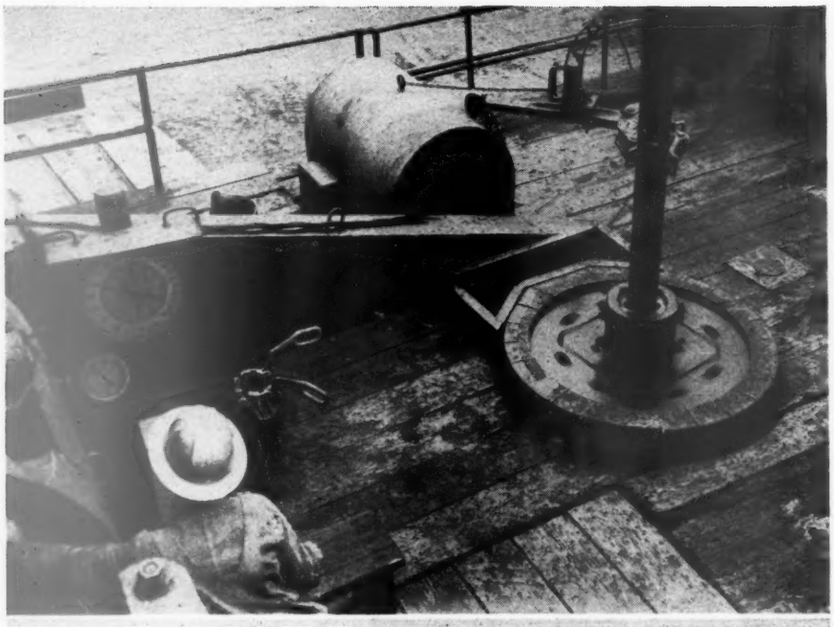
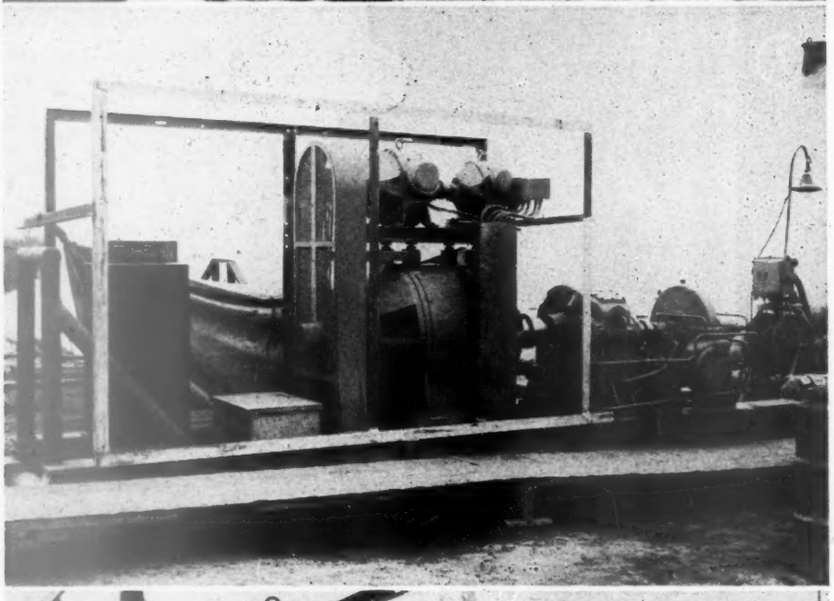




Top: **The mill type rotary motor can be operated with an output of 330 hp., although it is rated at 250 hp. at 750 r.p.m. with 395-v.**

Center: **The steam turbine, reduction gear, main and auxiliary generators, and switch boxes are unitized on a single set of heavy skids situated near the boilers along walk from the rig.**

Bottom: **The turbine bearings, reduction gear bearings, and gears, are lubricated by oil that is circulated through a water-cooled heat exchanger. The electric generator unit is covered temporarily by a tarpaulin that can be thrown over the angle-iron framework built on the skids.**

no voltage for building up a field in the opposite direction.

The blower motor does not have conventional motor starting equipment, but is connected directly on the 125-v. field circuit to the rotary motor. A disconnect switch, however, is in the line with the blower motor. This insures having the blower in operation whenever the field current is on the motor.

Advantages of the application of turbo-electric rotary drives to steam rigs are as follows:

1. Maintenance costs are less, because the drilling engines and drawworks are shutdown except when hoisting.
2. An average rotating speed of 150 to 200 r.p.m. can be maintained without difficulty.
3. Much noise and vibration is eliminated from the derrick floor.
4. The smooth transmission of power to the drill stem tends to reduce wear in the rotary table, kelly, and drill pipe.
5. Control of the drilling operation is facilitated, because the driller can tell how fast the pipe is rotating and how much torque is being applied.
6. Recording instruments may be attached to the motor that will keep a record of the rate and torque of rotation.
7. A small amount of steam is saved due to the efficiency of the turbine.
8. Inasmuch as the drawworks are not being used for driving the rotary, an automatic feed control may be installed.

Disadvantages of the application of turbo-electric drives to steam rigs are as follows:

1. Additional equipment to purchase, to move, and to maintain.
2. The equipment cannot be generally repaired by regular drilling crews.
3. Crowded condition of the ramp side of the rig floor when the coring unit is in place.
4. Additional rigging-up time.

Although some of the advantages and disadvantages listed are of minor significance, the important points must be considered carefully by anyone who plans to add an independent turbo-electric rotary drive to a steam rig. The experiments conducted by the Humble Oil and Refining Company on this new development points to improved steam rig drilling technique. ★ ★ ★

OIL IN THE MIDDLE EAST

By **ERNESTINE ADAMS,** *Associate Editor*

THE mystic lands of the Middle East have inevitably become the scene for a gigantic struggle for economic power. What may be the richest petroleum reserve in the world lies in the land of Arabian Nights, once the center of an ancient civilization. Aladdin and Ali Baba stood on treasure greater than any gold and gems they sought.

EXCLUSIVE

All three great world powers believe the rich oil deposits of the Middle East are vital to their economic progress. Great Britain and the United States hold the largest share of oil rights granted by Middle East governments. Russia had none until her recent reported agreement with Iran.

The entrance of Russia in Near and Middle East oil affairs was her logical first move to protect her rich Baku oil area by wider land margins, at the same time acquiring accessibility to vast petroleum stores. It could easily be that her production of oil has dropped sharply and stampeded the leaders responsible for economic affairs into sudden measures to obtain the needed resources.

Russia does not stand well in the world oil situation at the present time although she began development of her reserves about 1861, soon after the discovery of the Drake well that launched the United States industry. In the early part of the twentieth century Russia was the largest oil-producing country in the world with the United States second. Today the Soviet has the smallest production of the three great powers. In world petroleum reserves already developed and therefore available, the United States nationals own an estimated 55 per cent; Britain, 25 per cent, and Russia, 10 per cent.

In March, at the time when Red troops failed to evacuate Iran according to treaty, the Soviet newspaper Izvestia carried an article by Nikolai Baibokov, oil commissar, which asserted that the U. S. S. R. reserves were the world's largest. Many geologists agree that Russia has the largest potential oil resources and may ultimately recover two to three times as much petroleum as the United States. Regardless of potentialities, present *available* reserves in the Middle East are three to four times those *available* in Russia.

Russia needs more production and took the hard way to get her cut in reserves of oil-rich neighbors.

The last published figure for oil production for Russia was 222 million barrels in 1940 and the general impression is that no increase of any importance was made during the war or since. The Soviet has been secretive about her petroleum, but it is no secret that she had to be supplied from outside in order to pursue the war.

In 1940 some 72 per cent of her total production—161 million barrels—came from the Baku area, north of Iran. New flush production from flowing wells was said to keep up the Baku figures. The Soviet thus has a heavy concentration of its total oil production. This must serve a vast country where meager transportation facilities would hamper its use even in peacetime; in wartime the situation would be critical.

In Stalin's speech this spring when he named the economic objectives of the new state plan, he called for a 60-million-ton annual production within 15 to 20 years. In our terms this is about 450 million barrels. This is roughly twice the 1940 production and supports the speculation that Russia's production may now be the same as in 1940 or less. Compare the Soviet's 222 million barrels with the 1500 million barrels annual production of the United States and you have the reason Russia wants more oil.

In 1940 only one-half the amount of drilling was done that was called for in the 1938 Soviet plan, according to reliable reports. Only one-fourth to one-third of the planned exploratory drilling was carried out. Poor equipment is said to delay activity but the government frowns on importation of machinery that requires exchange. There have been instances, however, when big orders came through to United States manufacturers of oil field machinery—and perhaps to British firms, also—in a sort of desperate effort to push oil development.

So it would not be surprising to find that production in the Baku area had fallen drastically within a short time. A major source that depends upon drilling of new flowing wells to keep up production can fluctuate dangerously. Such a cut in oil production could persuade Russian leaders that they must acquire Middle East oil at any cost.

It is apparent that Russia obtained her Iranian oil agreement the hard way, if that were all she wanted. An American firm that made a geological survey of the area earlier did not take up its option. Britain had already suggested that Russia be included in the Middle East oil arrangements.

The area said to be involved in the new Russo-Iranian agreement does not necessarily mean any conflict between Russian and British interests in Iranian oil. The British concession lies in western Iran and the natural outlet for its oil is through the Persian Gulf, whereas the territory in which Russia is interested lies on the other side of the great Iranian mountain range and the natural outlet for oil from this area would be into or through Russia.

The Middle East reservoir has been developed by oil-wise American and British companies, by French and Dutch interests. Table 1 is a list of the countries, their annual production, an estimate of presently available oil, and ownership in nationals.

TABLE 1

Country	1944 production	Proved reserves*	Ownership in nationals
Iran	100,375,000†	5,000,000,000	Great Britain
Iraq	32,859,000	4,000,000,000	Great Britain, United States, France, Netherlands
Kuwait	Shut in	4,000,000,000	United States, Great Britain
Saudi Arabia, Bahrein	‡2,775,000‡	2,000,000,000	United States
Qatar	Shut in	500,000,000	Great Britain, United States, France, Netherlands

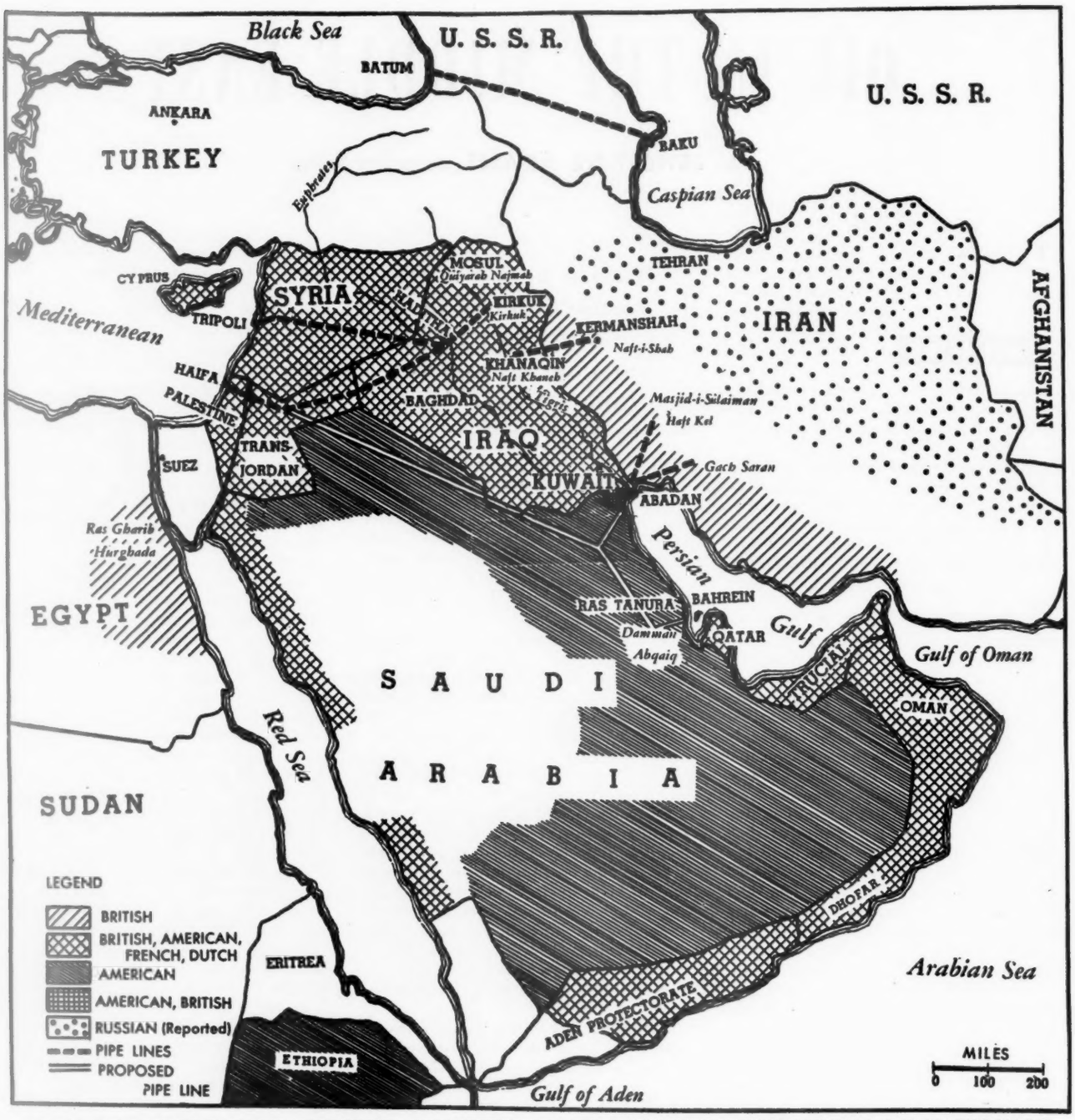
*E. DeGolyer, chief of the Technical Oil Mission to the Middle East, reported in February, 1944, that "if one considers reserves as proved by developed fields and indicated by fields discovered but not yet fully explored, the proved and indicated reserves in Kuwait appear to be approximately 9 billion barrels, those in Iran 6 to 7 billion barrels, Iraq 5 billion barrels, Saudi Arabia 4 to 5 billion barrels and Qatar 1 billion barrels," a total of almost 27 billion barrels, 6 billion more than U. S. proved reserves.

†1945 production, 127,403,874 bbl.

‡1945 production approximately doubled—21,310,996 bbl. for Saudi Arabia only.

IRAN

● **Concessions.** In 1901 Iran sold a concession covering some 500,000 sq. mi. for a period of 60 years to British interests. Under terms of a new agreement in 1933 a concession was signed with the Anglo-Iranian Oil Company, Ltd., extending the terms to 1993 and restricting the zone to 100,000 sq. mi. in the southwestern part of the country. Of the £33,000,000 capital, £11,250,000 ordinary and £1000 first preference stock is held by the British government.



MAP OF MIDDLE EAST SHOWING HOLDERS OF PETROLEUM CONCESSIONS BY NATIONALS

Most of the rights in the rich petroleum deposits of the Near and Middle East are held by: the British, who own the concessions in lower Iran and in Egypt; Americans, in Saudi Arabia, Bahrein Island, and Ethiopia; a group that includes British, American, French and Dutch interests in Iraq, Syria, Palestine, Trans-Jordon, Isle of Cyprus, Western Arabia, Qatar and Dhofar, and an American-British combination, in Kuwait. Russia reports an agreement with Iran for a concession in the north part of that country to be granted to a partnership of Russia and Iran. This will be the Soviet's first venture in Middle East oil development if it goes through. The report says that a neutral area will be left between Turkey, Iraq, and the British concession on the west and south, and the new Russo-Iranian owned concession in the north.

In the reported tentative agreement between Russia and Iran a company has been set up for development of oil in the northern section of Iran. Russia, which is to finance the project, supplying technicians, equipment, etc., will hold 51 per cent of the stock for 25 years with Iran possessing 49 per cent. After that period the stock will be owned 50-50 by the two countries for another 25 years. The territory involved, according to Moscow radio reports, begins on the Turkish and Iraq borders on the east and covers the entire north and central Persia to the Afghanistan border on the West. The agreement is contingent upon withdrawal of Russian troops and passage by the Iranian parliament.

Oil companies now holding Middle East concessions pay much less royalty than might be gained on such a basis as the proposed partnership. American oil men assert that this appears much more attractive than it could work out, assuming that expense of development is drawn from proceeds of the oil discovered.

● **Production.** Production in Iran has come chiefly from Masjid-i-Sulaiman and Haft Kel (near Shushtar), which are about 35 miles apart and about 100 miles northeast of the Abadan refinery. The first production was discovered in 1908 at Masjid-i-Sulaiman. Later devel-

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opments brought in the fields of Gach Saran, 125 miles southeast of Haft Kel, Agha Jari, 50 miles southeast of Haft Kel, and of Naft-i-Shah, near Kermanshah.

Iranian oil is the main source of fuel for the British fleet.

Production in Iran fields runs:

Fields	Wells	Bbl. per day
Haft Kel	25	200,000
Masjid-i-Sulaiman	30	60,000
Gach Saran	7	70,000
Agha Jari	15	70,000
Naft-i-Shah	10	1,800
Total		401,800

● **Refineries and pipe lines.** The big refinery is the Anglo-Iranian plant at Abadan, which processes some 360,000 bbl. a day. Pipe lines from the three largest fields carry the oil to the Island of Abadan in the north end of the Persian Gulf. An auxiliary loading terminal is at Khosrowabad, 15 miles away. Production from Naft-i-shah is carried by pipe line to Kermanshah refinery, operated by a subsidiary of Anglo-Iranian, Kermanshah Petroleum Company. Plans are ready for another refinery and port near Bandar Mashur, on the Khor Musa waterway, which will be the terminal for the production from the Gach Saran field.

IRAQ

● **Concessions.** In 1925 the Iraq government granted a concession to the Iraq Petroleum Company, Ltd. Under a revised agreement in 1931 the company was given the sole right for a period of 75 years from 1925 to exploit the oil deposits in the vilayets of Baghdad and Mosul, east of the Tigris River, the whole covering 32,000 sq. mi.

The Iraq Petroleum Company shares are held by: The Anglo-Iranian Oil Company, Ltd., (through the D'Arcy Exploration Company, Ltd.) 23¾ per cent; Royal Dutch-Shell group (through the Anglo-Saxon Petroleum Company, Ltd.), 23¾ per cent; Compagnie Francaise des Petroles, a French group, 23¾ per cent; Near East Development Corporation, owned equally by Standard Oil Company of New Jersey and Socony-Vacuum Corporation, 23¾ per cent, and Participations and Investments, Ltd., 5 per cent.

A second concession was granted to the British Oil Development Company in 1932 covering all of Iraq west of the Tigris River and north of the 33rd parallel of lattitude. Mosul Petroleum Company, controlled by Iraq Petroleum, now holds and operates this concession.

Basrah Petroleum Company, Ltd., owned by the same group interested in Iraq Petroleum Company and in the same proportions, has a third concession from the Iraq government for a period of 75 years from 1938, providing for exclusive oil rights in that portion of the country not leased by either of the above, including territorial waters, islands, etc., comprising some 94,500 sq. mi.

Khanaqin Oil Company, Ltd., a subsidiary of Anglo-Iranian Oil Company operates in the territory on the Iran-Iraq border.

● **Production.** The Kirkuk field, discovered in October, 1927, is by far the largest in Iraq. Production for Iraq in 1940 was:

Field	No. wells	Bbl. per day	Operator, company
Kirkuk	42	90,000	Iraq Petroleum
Naft Khanek	7	400	Khanaqin Oil
Quiyarah and Najmah	53	100	Mosul Petroleum

● **Refineries and pipe lines.** The Consolidated Refineries, jointly owned by Anglo-Iranian Oil Company and Shell, has a refinery at Haifa, in Palestine. By agreement the American and French groups have limited processing rights in the Haifa refinery. A pipe line to terminals at Haifa and Tripoli, in Syria, was opened in January 1935. It has a capacity of 31,000,000 bbl. annually.

The Khanaqin Oil Company has a refinery on the banks of the Alwand River, close to the town of Khanaqin. Oil is pumped 25 miles from Naft Khanek to the refinery and after being processed it is piped 3 miles to the terminus at Khanaqin.

SAUDI ARABIA, BAHREIN ISLAND

● **Concessions.** Standard Oil of California and The Texas Company each own 50 per cent of the shares in Arabian American Oil Company and Bahrein Petroleum Company. Arabian American holds a long term concession from the Saudi Arabian government covering approximately 439,500 sq. mi. and preferential rights over an additional 117,000 sq. mi.

Bahrein Petroleum Company, Ltd., holds oil rights over 100,000 acres on Bahrein Island in the Persian Gulf. During 1939 the company acquired the remainder of the island not under lease and all territorial waters, etc. The island is 32 miles long and about 10 miles wide.

● **Production.** Saudi Arabia in 1945 had 34 wells, 28 at Dammam field, 5 at Abqaiq and 7 at the Qatif field, which lies between Dammam and Ras Tanura. It was discovered in 1945. Present production is in excess of 150,000 bbl. daily.

● **Refineries and pipe lines.** The refinery at Ras Tanura has been expanded to handle 80,000 bbl. per day. A port was constructed near the refinery on the Persian Gulf, about 43 miles from Dammam field, Province of Al Hasa, and a 10-in. pipe line laid. A supplementary 12-in. pipe line is laid from the shore for the loading of tankers. A new submarine pipe line with an ultimate capacity of 50,000 to 60,000 bbl. per day has been laid from the Dammam field to the refinery on Bahrein Island. There is now a 12-in. line from the Abqaiq field to Dhahran and a 12-in. line is being laid from Dhahran to Ras Tanura. Dhahran is the headquarters camp of the company.

The refinery at Manama, Bahrein Island, has a capacity of 60,000 bbl. It handles the 20,000 bbl. per day of the 70 wells on the island and production from the Saudi Arabian wells. A stabilization plant is situated at Dhahran.

KUWAIT AND QATAR

● **Concession.** Kuwait Oil Company has been granted exclusive oil rights in the entire territory of the Sheikh of Kuwait. The land is on the northwest angle of the Persian Gulf. Shares in the company are held equally by Gulf Exploration Company, a subsidiary of Gulf Oil Corporation, and D'Arcy Exploration Company, Ltd., a subsidiary of Anglo-Iranian Oil Company.

SYRIA AND PALESTINE

● **Concession.** Petroleum Concessions, Ltd., holds oil rights in Syria, Palestine, and western shore of the Persian Gulf. The company is controlled by Iraq Petroleum Company.

Other rights in Palestine are held by Petroleum Development (Palestine), Ltd., also controlled by Iraq Petroleum Company.

● **Pipe lines.** The Iraq Petroleum Company has two great oil shipping terminals at Tripoli and at Haifa. From Kirkuk, Iraq, a pipe was laid 618 miles to Haifa, passing through Trans-Jordan. The line to Tripoli passes through Palmyra, covering the 531 miles from the field to the terminal. The two lines separate at Haditha.

EGYPT

● **Concession.** On the western shore of the Red Sea oil properties are held under lease from the Egyptian Government by Anglo-Egyptian Oilfields, Ltd., along with exploration permits over various other areas. The Egyptian government owns shares in the company.

● **Production.** Two fields, Ras Gharib with 32 wells and Hurghada, with 75 wells, produce some 20,000 bbl. a day.

The company owns a refinery at Suez capable of handling some 15,000 bbl. a day and tank storage capacity of 190,000 bbl.

OTHER COUNTRIES

Petroleum Development, Ltd., a subsidiary of Iraq Petroleum Company, including British, American, Dutch and French interests, has acquired concessions and options under various registrations in Oman and Dhofar, Qatar, Trans-Jordan, Trucial Coast, Western Arabia and the Island of Cyprus in the Mediterranean. Qatar is the only one of these with any development and at last report wells were shut in in this region.

★ ★ ★

Refinery planned for Baiji, Iraq, for home products

The Iraq government is planning to build its own oil refinery at Baiji, in northern Iraq, in the near future, according to the Baghdad press. It is stated that the Iraq authorities have asked their consulting engineers in London to re-examine the refinery scheme for Baiji, which was drawn up before the war, with a view to bringing it up to date. Upon completion of the new design and specifications, bids for its construction will be invited by the Iraq government. Capacity of the plant will be 300,000 tons a year.

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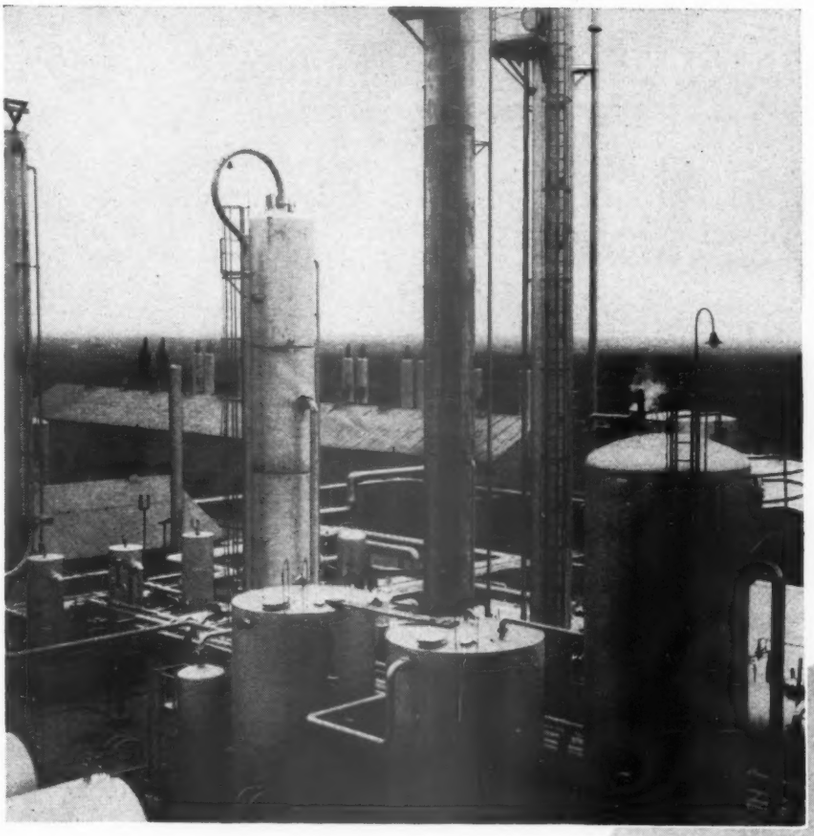
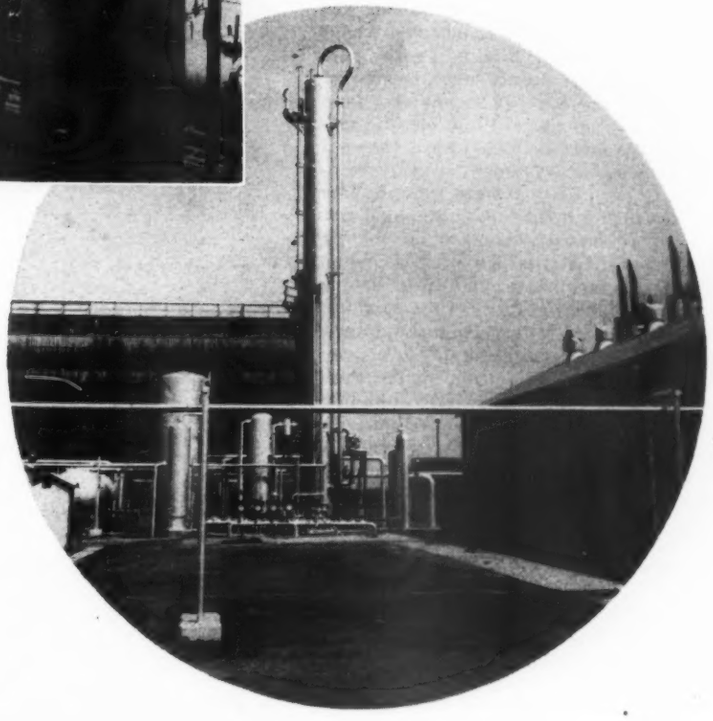
Natural Gasoline Plant and Refinery Equipment IN WORLD-WIDE USE





The Bubble Towers and Pressure Vessels for the new Continental Oil Company plant in the K. M. A. Field, Texas, were built for the Jones and Laughlin Supply Corporation.

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PACIFIC COAST PIPE COATING AND RECONDITIONING

By **THOMAS R. FLYNN,** Tubular Engineering Company

EXCLUSIVE

IN KEEPING with the critical demand, which arose during the final year of the war, 1945, for rapid, high quality pipe processing and treatment, both by the armed forces and by industry, Tubular Engineering Company entered the pipe processing and reconditioning field. In less than a year's time more than 1,000,000 ft. or approximately 200 miles of pipe of all sizes varying from ¼ in. to 26 in. has been processed.

More than 700,000 ft. of pipe varying in size from ¼ in. to 22 in., light weight and standard, threaded and plain end, was processed for the armed forces for overseas shipment and use. The processing of 4-in. and larger pipe consisted of cleaning inside and out and spray painting with two coats of rust preventive paint of Army specifications. Cleaning on the outside was done with stationary rotary brush pipe line cleaners, whereas the inside of the pipe up to 16 in. was cleaned with rotary wire brushes. Pipe greater than 16 in. in diam. was cleaned on the inside by means of chain rattlers to which Studite knobs were welded. These rattlers were rotated in the stationary pipe by means of a long rigid shaft connected to an electric motor that was carriage-mounted. Internal spray painting was done by using withdrawing type spray equipment. The spray guns were inserted in the pipe and the pipe was sprayed from the middle to the ends. External spraying was done by passing the pipe through spray booths situated at the discharge of the cleaning machines. Each spray booth contained 4 fixed nozzles, each set to cover one quadrant of the pipe. Pipe smaller than 4-in. was cleaned externally, bundled and double dipped. The entire job was completed in approximately two months time. Recent inspection of government stockpiles of unused portions of this pipe revealed that this processing is providing excellent protection and should continue to do so for years to come.

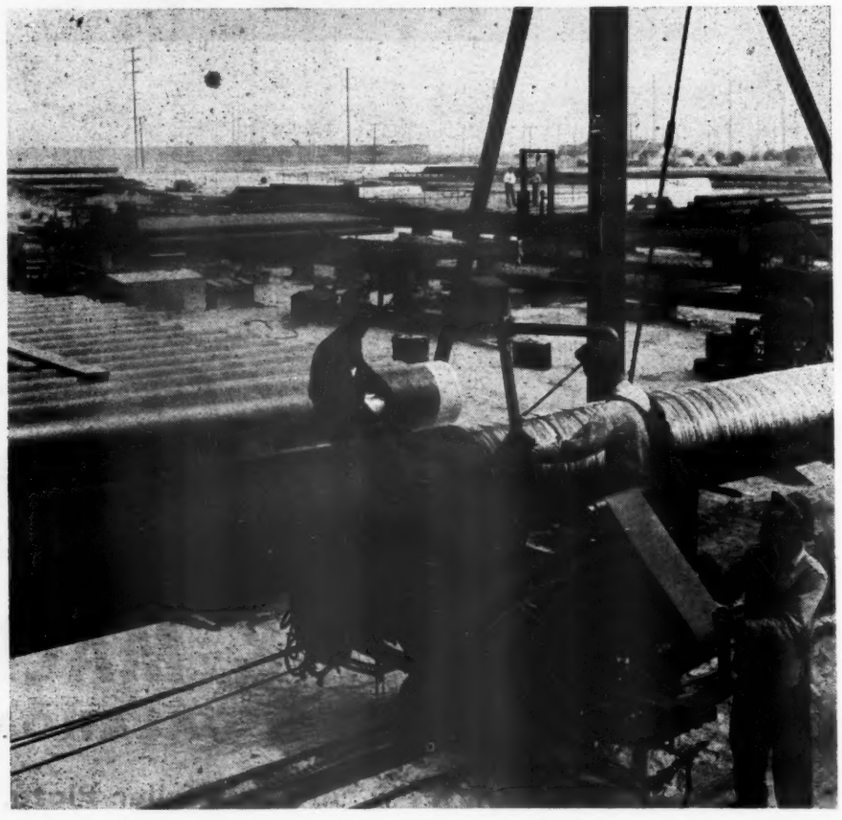
In addition to processing for the armed forces for overseas shipment, processing for overseas shipment to South America of about 10,000 ft. of 2-in. pipe and 10,000 ft. of 4½-in. drill pipe for a major western oil company was recently completed.

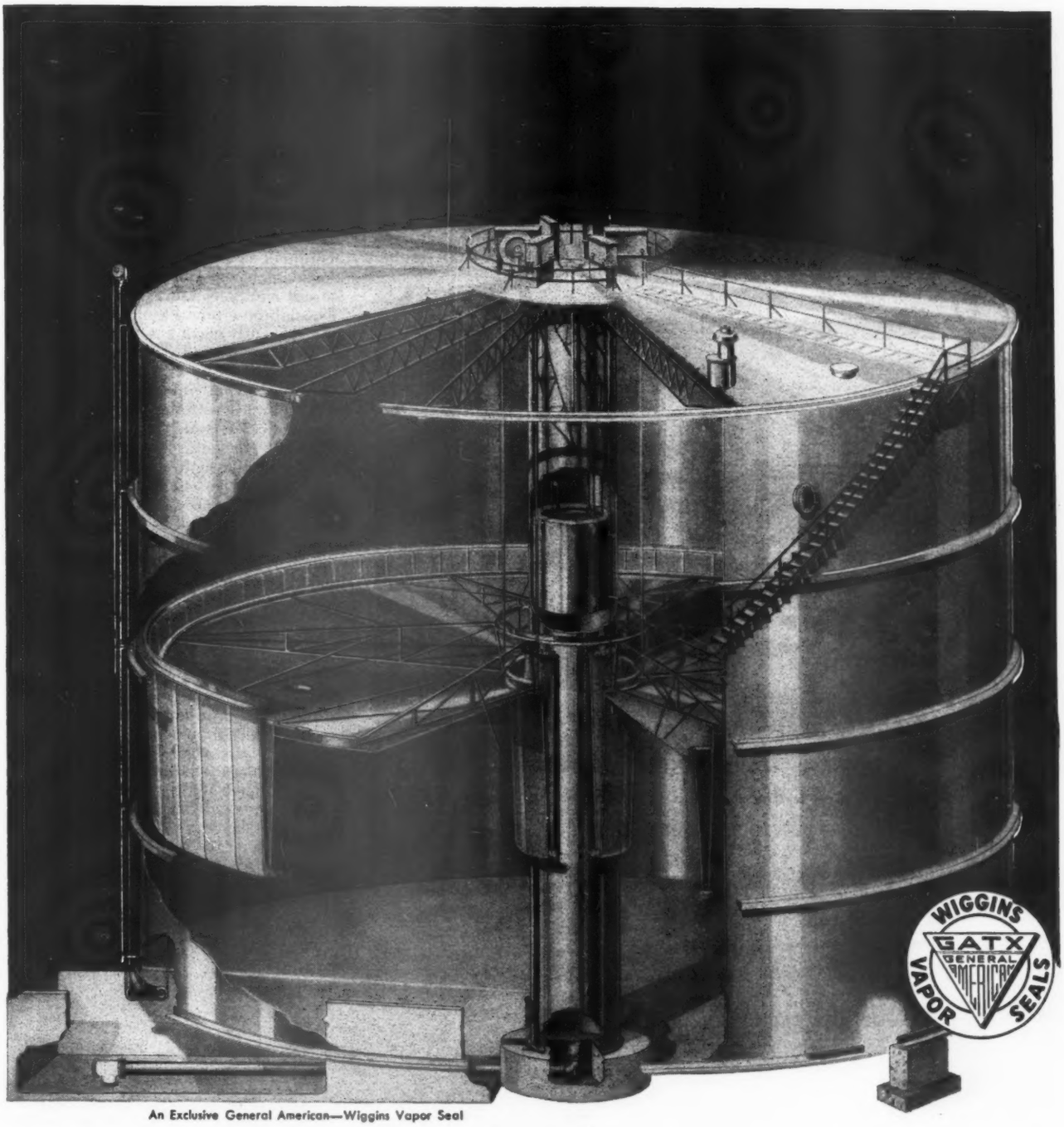
Not only processing jobs but a considerable number of reconditioning and coating jobs on water, oil, and gas lines have been handled.

Approximately 47,000 ft. of 8-in. water line to be used in the desert area of Southern California was coated with a single tar coating and wrapped with a 15-lb. asbestos pipe line felt.

FIG. 1. Applying two cellophane wrappings simultaneously.

FIG. 2. Application of final wrapping, 26-in. gas pipe.





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One of the most interesting oil lines jobs consisted in reconditioning 71,000 ft. of 10¾-in. screwed pipe that had been in service for almost 25 years. The procedure consisted in burning off old material from the outside of the pipe and sludge from within, straightening bent pipe, removing rust scale, scarfing off threads and collars, welding into doubles, cutting out badly pitted pipe, welding deep pits, and hydrostatically testing to 1000 lb. per sq. in. The pipe was then primed and given two coats of hot enamel and two wraps of felt in accordance with customers' specifications. An interesting fact derived from an analysis of this job showed that less than 4 per cent of the total pipe reconditioned had to be rejected and cut out. Such a figure represented the pipe loss after approximately 25 years of service under heavy operation and adverse soil conditions.

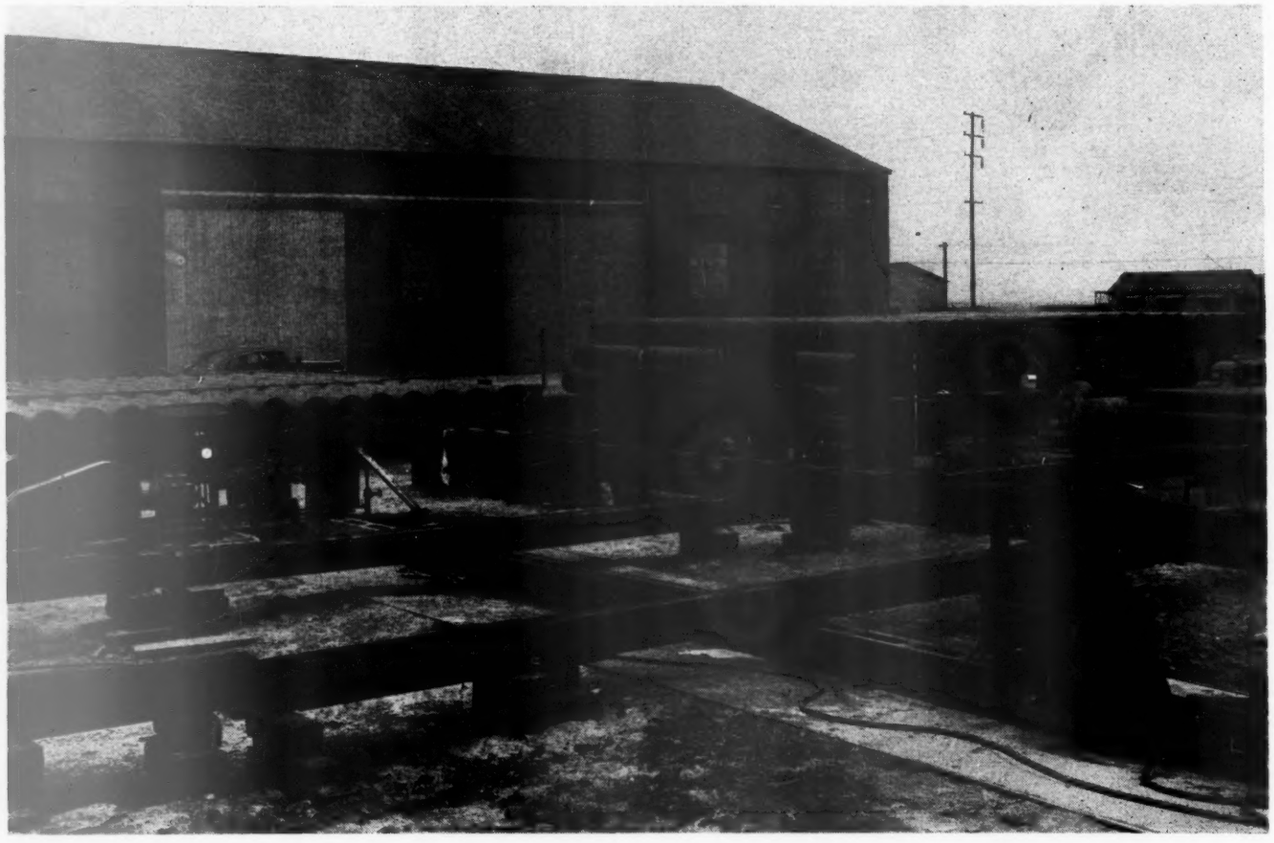
Large pipe, part of a new 26-in. gas line, was treated with excellent results. About 27,000 ft. of this pipe was cleaned, primed, asphalt-coated, and given two simultaneous wrappings of cellophane (see Fig. 1.). This was followed by a second coat of asphalt and a final wrapping of 15-lb. asphalt saturated felt (see Figs. 2 and 3).

FIG. 3. Completed joint.

FIG. 4. Hydrostatic pipe testing machine, 1500 lb. per sq. in. capacity

At present the plant and yard covers an area of more than 10 acres and is completely equipped to process, coat, or recondition any size pipe up to 30 in. in diameter. In addition to the cleaning, testing (see Fig. 4), sandblasting, and wrapping equipment already installed, the plant is especially proud of its two newest additions. One, a new two-wheel Wheelabrator pipe cleaner will rapidly and efficiently clean any pipe in sizes up to 40 in. by means of abrasive shot thrown at high velocity against the rotating and forward moving pipe. This machine is also equipped with the latest "Dustube" dust collector, which will insure more all-round efficient plant operation and will result in more healthful working conditions. The other addition, which replaces and improves on an earlier successful pilot model, is a specially designed drying and storage chamber. This chamber, designed and installed by the plant superintendent, Carl Tennant, was added to insure a constant temperature and humidity for all wrapping materials used, thus affording complete protection to all such materials.

In addition to plant coating and wrapping, portable equipment for treatment in the field is available. Such equipment assures effective and uniform treatment and often saves handling and trucking costs, yet does a job that approaches a lathe-wrapped job. ★ ★ ★



VOLATILE HYDROCARBONS SEPARATED FROM CONDENSATE AT SHERIDAN CYCLING PLANT

By **WILLIAM J. DAVIS,** *Associate Field Editor*

EXCLUSIVE

EARLY in the stages of World War II the demand for highly volatile hydrocarbons was such that they could be supplied from sources that had already been developed. As the war progressed to its mid-stage it became all too apparent to Washington petroleum planners that the need for volatiles such as butane, isobutane, pentane, and isopentane—all of which could be supplied from gas-condensate wells with proper plant processing—would soon far exceed the fields known and being utilized at that time. A reconsideration by PAW officials of former applicants who desired to erect plants for the processing of gas from proved condensate fields soon resulted in permission being granted for a score or more plants throughout the country that proposed to produce liquefied petroleum gases as well as accomplish cycling operations and the manufacture of natural gasoline.

The Sheridan field, Colorado County, Texas, offered an excellent opportunity with its limited number of operators in the field, few wells, and a favorable condensate gas ratio averaging 45 to 50 bbl. per million cubic feet of gas. Permission was granted by PAW in the fall of 1943 to Shell Oil Company, Inc., to proceed with proposed plans for unitization of the field and construction of a cycling plant in the Sheridan field that would include fractionation units, and priorities were released for the necessary materials to be used in its construction.

The site selected for the Sheridan plant was an unusually level parcel of land situated in the middle of the Sheridan field in the Francis Mayar Survey, and consisting of 32 acres. It is also close to a branch of the Southern Pacific Railroad. The work of clearing land for construction was begun June, 1944, and the plant was put into operation August, 1945.

The plant is designed to handle a throughput of 100,000,000 cu. ft. of gas and condensate mixture daily from the 10 dual completion wells connected to the gathering system. The wells produce from a 9300-ft. and a 10,300-ft. zone in the Wilcox series. Five other wells are used as injection wells with dry gas being returned to the reservoir at 4350 lb. per sq. in. Well pressures in the field averaged 1800 lb. per sq. in. Gas enters the plant at well pressure and no separator is used at the wellhead.

Analysis of condensate samples is shown in Table 1.

Close aerial view of Sheridan cycling plant, camp in background.

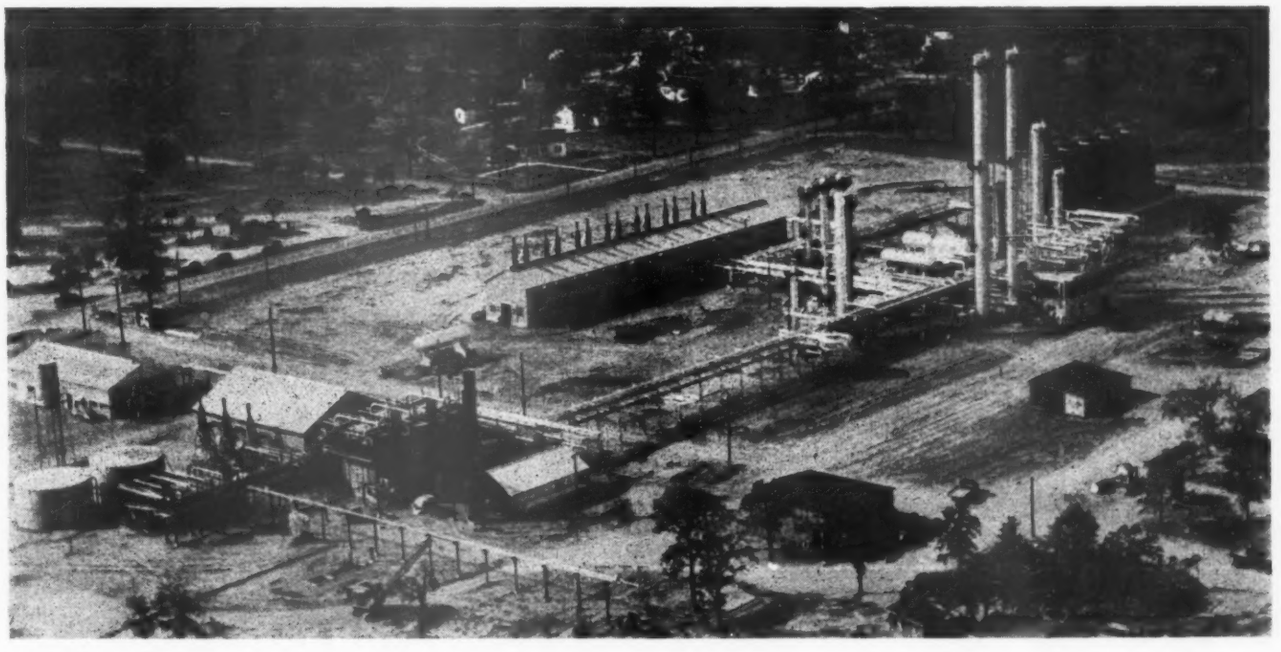
Recovery efficiencies are held to 85 per cent minimum for butanes and 99 per cent for isopentane and heavier hydrocarbons, 25 per cent of inlet propane having been incidentally recovered. Purity of isobutane, normal butane, and isopentane is maintained at 95 per cent minimum.

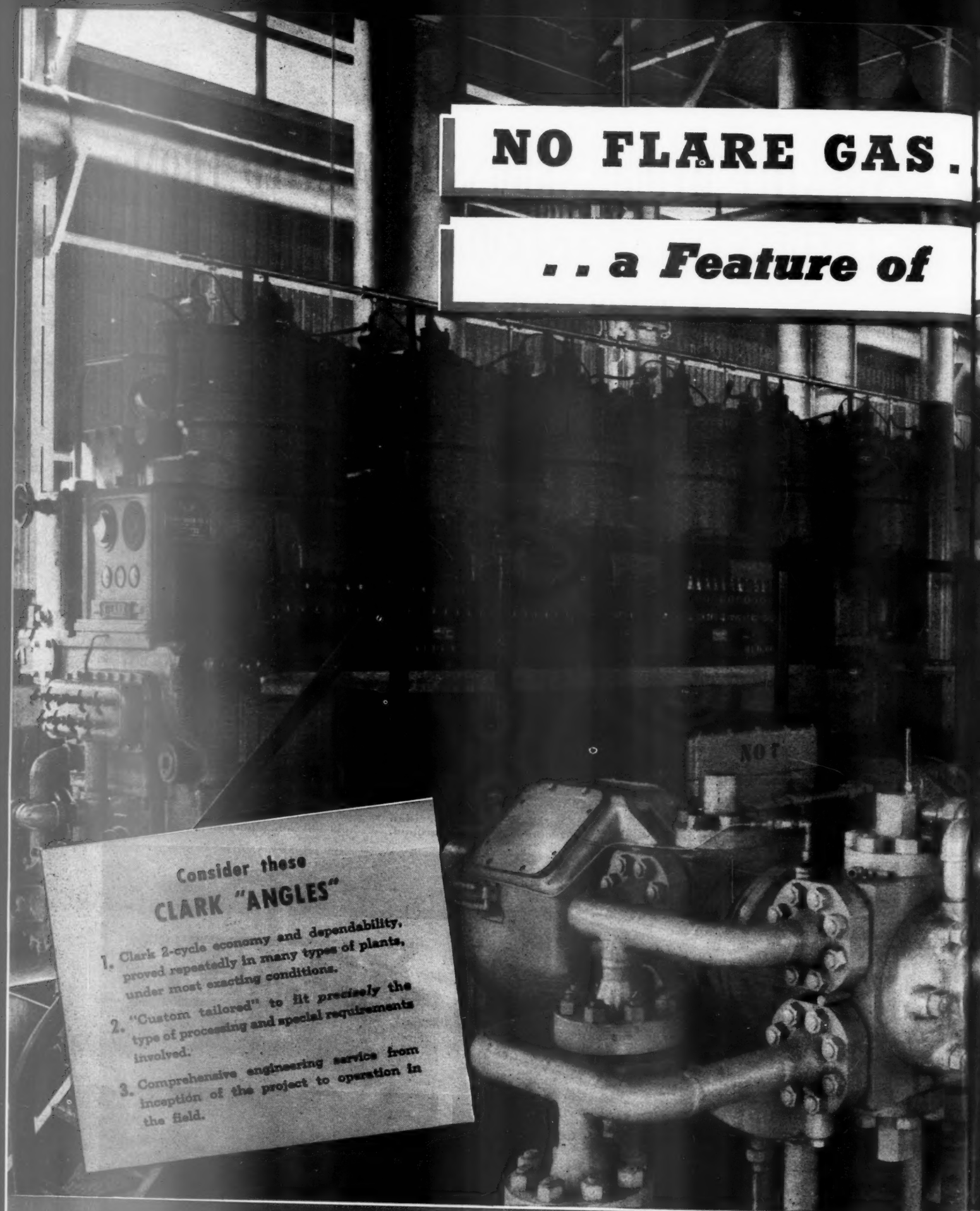
Absorption oil is obtained from charge to plant and is held to approximately 35-40 deg. API and a boiling range of 450-640°F.

Plant load and conditions for 24-hr. operation, which in turn determined the design and selection of equipment, is based on the calculated quantities shown in Table 2.

Layout is spacious and simple throughout the entire plant. All equipment has been grouped into 5 principal areas. The area containing water wells, boilers, generators, and oil heater is isolated from the absorption, distillation, and fractionation areas by a generous margin.

Liquid-level controls automatically shut down engines in the event liquid accumulates excessively in pressure vessels connected to compressor suction manifold. Pilot-operated control valves are supplied with 40 lb. per sq. in. instrument air reduced to 17 lb. per sq. in. at the instrument. Instrument air is supplied by 2-in. piping throughout the plant

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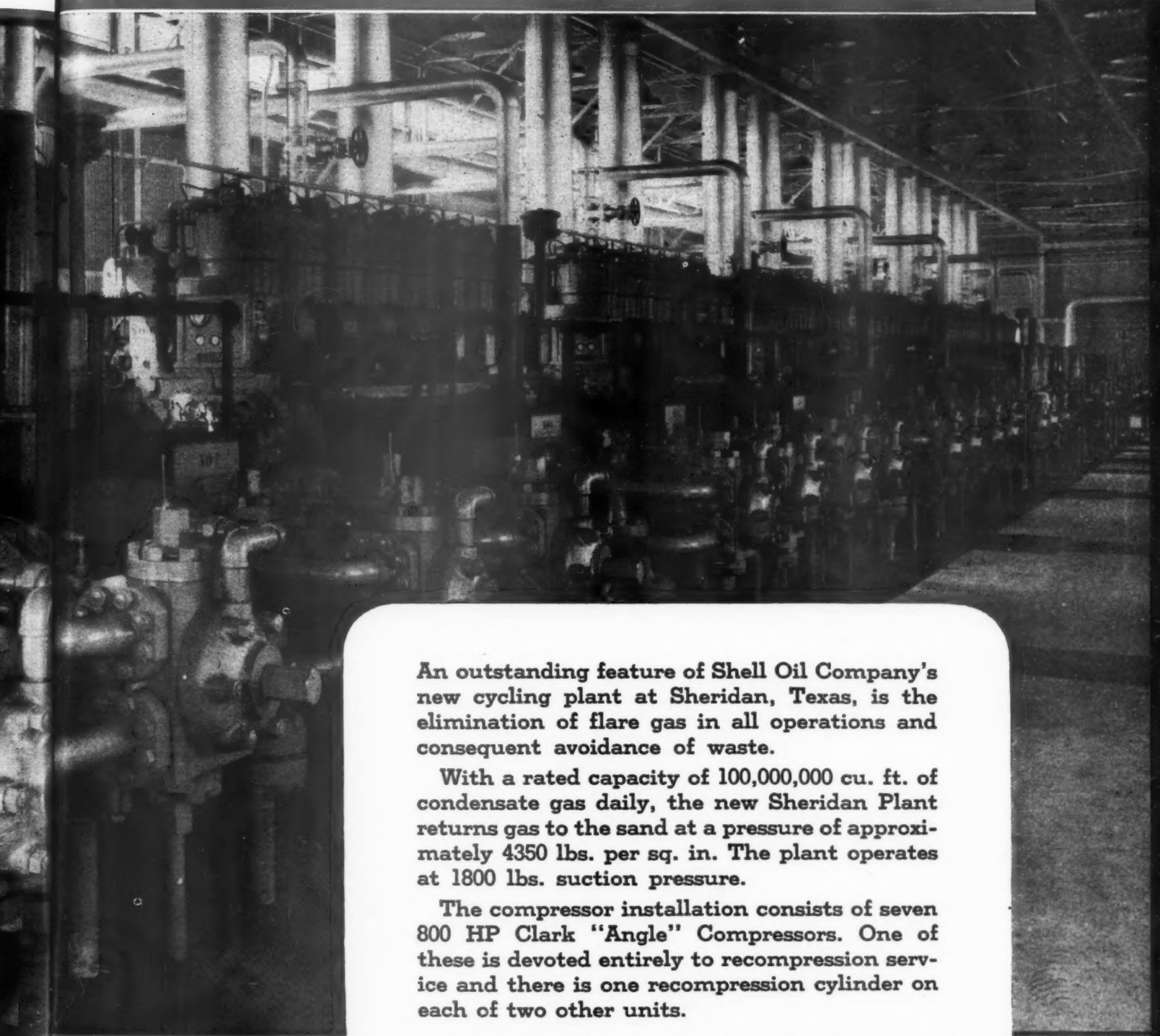
SHELL'S New Cycling Plant



An outstanding feature of Shell Oil Company's new cycling plant at Sheridan, Texas, is the elimination of flare gas in all operations and consequent avoidance of waste.

With a rated capacity of 100,000,000 cu. ft. of condensate gas daily, the new Sheridan Plant returns gas to the sand at a pressure of approximately 4350 lbs. per sq. in. The plant operates at 1800 lbs. suction pressure.

The compressor installation consists of seven 800 HP Clark "Angle" Compressors. One of these is devoted entirely to recompression service and there is one recompression cylinder on each of two other units.

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from a water-cooled, reciprocating, simplex, steam-driven air compressor operating on 200-lb. steam. An oil separator and air filter purify instrument air after which propane chillers remove undesirable moisture.

● **Gas cycle.** Gas and entrained condensate arriving at the plant by way of an 8-in. delivery line at a pressure of 1800 lb. per sq. in. and a temperature of 120°F., is introduced to 2 gas scrubbers connected in parallel permitting the deposition of mud, water, and pipe scale. The gas is then passed through 16 gas coolers arranged in 4 parallel banks of 4 coolers each.

The gas stream is split to enter the base of two 60-in diam. by 53-ft. high pressure absorbers operating at 1800 lb. per sq. in. Lean oil from the lean oil surge tank is introduced at the top of each absorber at the rate of 250 to 300 gal. per min. and 90°F. by means of a 10-stage centrifugal pump discharging at a differential pressure of 1840 lb, per sq. in. and driven from each end by turbines, one turbine exhausting at 65 lb. per sq. in. to supply process steam demand, the other exhausting at 5 lb. per sq. in and carrying the rest of the pumping load. There is an identical pumping unit for standby.

Dry gas from both absorbers passes through a 60-in. diam. by 11-ft. 2-in. residue scrubber operating at 1800 lb. per sq. in. before entering the compressor suction manifold.

There are 7 compressors to handle gas in the plant. All are 14-in. by 14-in., 300-r.p.m., 800-hp., angle-type compressors operating on natural gas. The 8 power cylinders and 4 compressor cylinders are connected to a common crankshaft. Compressor No. 1 is used solely for recompressing vented gas for use in the plant process. Compressors No. 2 and 3 recompress for plant processing with 2 cylinders and deliver high pressure gas to the field with their other 2 cylinders. Compressors No. 4, 5, 6, and 7 compress dry gas in one stage from 1800 lb. per sq. in. to the final injection pressure averaging 4350 lb. per sq. in. All compressors are equipped with induced draft cooling jackets surrounding the exhaust muffler as well as air filters, oil filters, and protective shut-down switches.

TABLE 1

	Mol. per cent
Methane	83.16
Ethane	6.73
Propane	3.85
Isobutane	0.84
N-butane	1.24
Isopentane	0.46
N-pentane	0.45
Hexanes and heavier	3.27
	100.00

TABLE 2

Composite charge to plant	100,000,000 cu. ft. per day
Residue gas	92,897,900 cu. ft. per day
Propane	32,088 gal. per day
Isobutane	21,216 gal. per day
N-butane	35,328 gal. per day
Isopentane	16,200 gal. per day
N-pentane (natural)	55,416 gal. per day
Topped distillate	137,760 gal. per day
Composite products	298,008 gal. per day

Rich oil from the bottom of both absorbers is piped to the first-stage flash tank along with a second liquid of lower gravity but greater volume from the blind tray placed below the 16 trays in each absorber. These 2 feeds to the first-stage flash tank are kept separate by a baffle plate whereas the vapor space is open to the surfaces of both liquids.

Gas flashed from this vessel is joined by gas recompressed by No. 1 compressor's third cylinder and introduced to the 30-in. diam. by 10-ft. third-stage booster scrubber. The gas is discharged to the main residue gas scrubber before final compression and field injection.

Bottoms from the first-stage flash tank become feed to second-stage flash tank, the gravity having been reduced from 11 to 13 per cent in the first stage. In the second stage flash the 2 liquids are divided by a baffle plate as in the first stage.

Vented vapors from the second-stage tank are joined by gas from the third-stage flash tank. The 2 streams are fed to a 36-in. diam. by 51-ft., 20-tray reabsorber where the desirable components are reabsorbed, countercurrent to absorption oil pumped at a rate of 60 to 70 gal. per min. by a 6-stage centrifugal pump operating against a pressure differential of 470 lb. per sq. in. A 40-hp. electric motor drives the pump, and an identical unit is used for standby purposes.

Reabsorber residue gas in excess of plant fuel requirements enters a second-stage booster scrubber identical in size but operating at a lower pressure than the third-stage booster scrubber after which it is recompressed in the third cylinder on No. 1 compressor for return to the injection wells.

Bottoms from the absorber, as well as low and high gravity liquid from the second-stage flash tank, are led to the third-stage flash tank for further flashing as 2 separate liquids in the same vessel. The route of the resultant gas and vapor formed has been described previously. The lighter bottom from the third-stage flash tank is heated from 75°F. to 265°F. in a 3-unit heat exchanger by means of hot distillate stripper bottoms. At 265°F. and approximately 65 lb. per sq. in., it enters the top of the distillate stripper.

The rich absorption oil from the third-stage flash tank bottom at about 43 deg. API and 95°F. comprises approximately 85 per cent of the charge to the fractionating still. All 3 flash tanks are horizontal vessels measuring 60 in. in diameter by approximately 13 ft. long.

● **Distillation.** Rich oil from the third-stage flash is heated in 6 heat exchangers and the vapors formed by the heating are allowed to flash off in a 48-in. diam. by 8-ft. horizontal fourth-stage flash tank and are then introduced into the fractionating still about 8 trays from the bottom.

Heat is further added by means of a direct-fired 48-tube oil heater that is capable of imparting 28,000,000 B.t.u. per hr. through twelve 12-in. burners to

View of the Shell Oil Company cycling plant at Sheridan, Texas ... one of the numerous gas processing plants designed and constructed by Petroleum Engineering, Inc., during its 16 years service to the industry.
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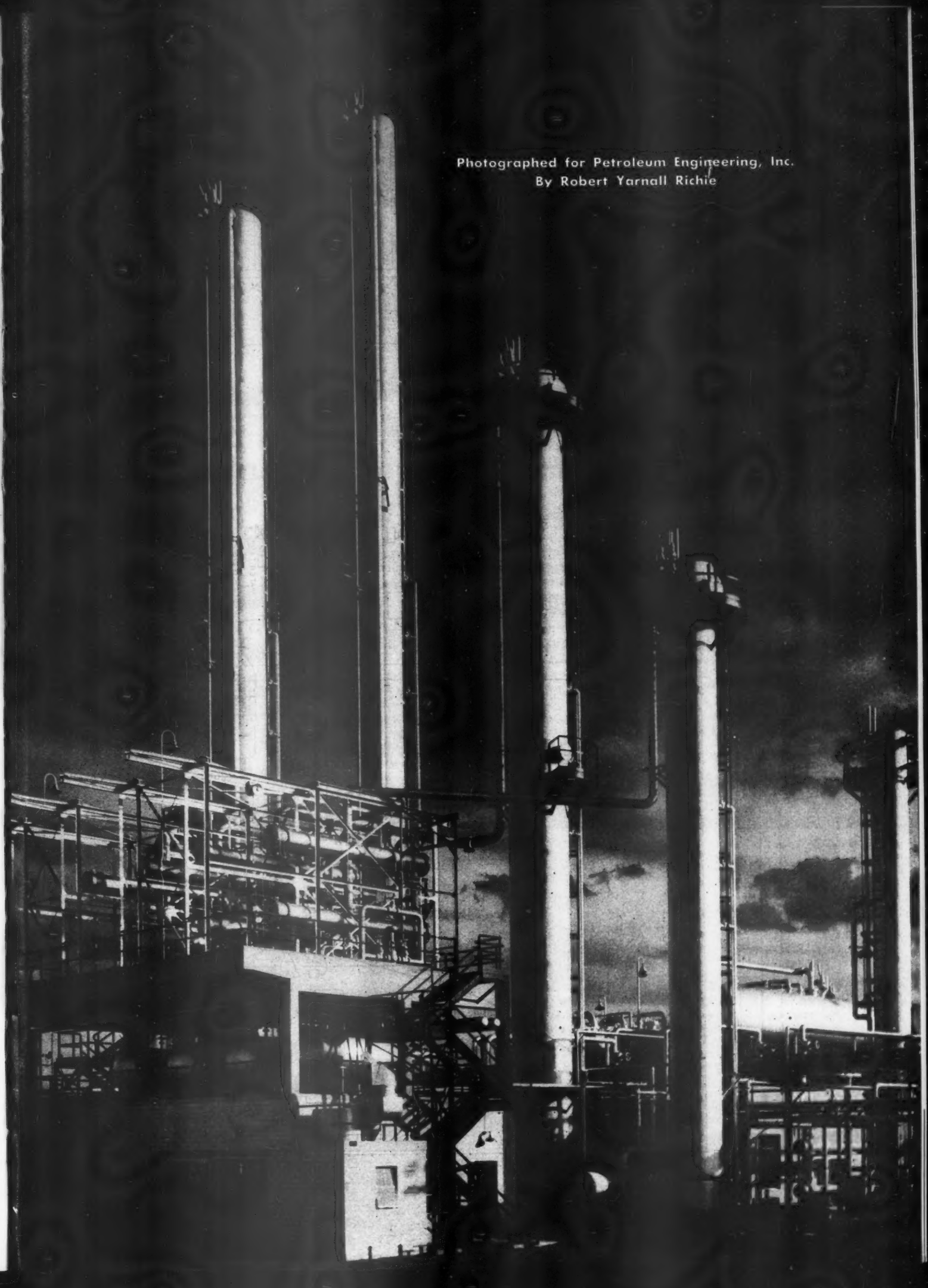

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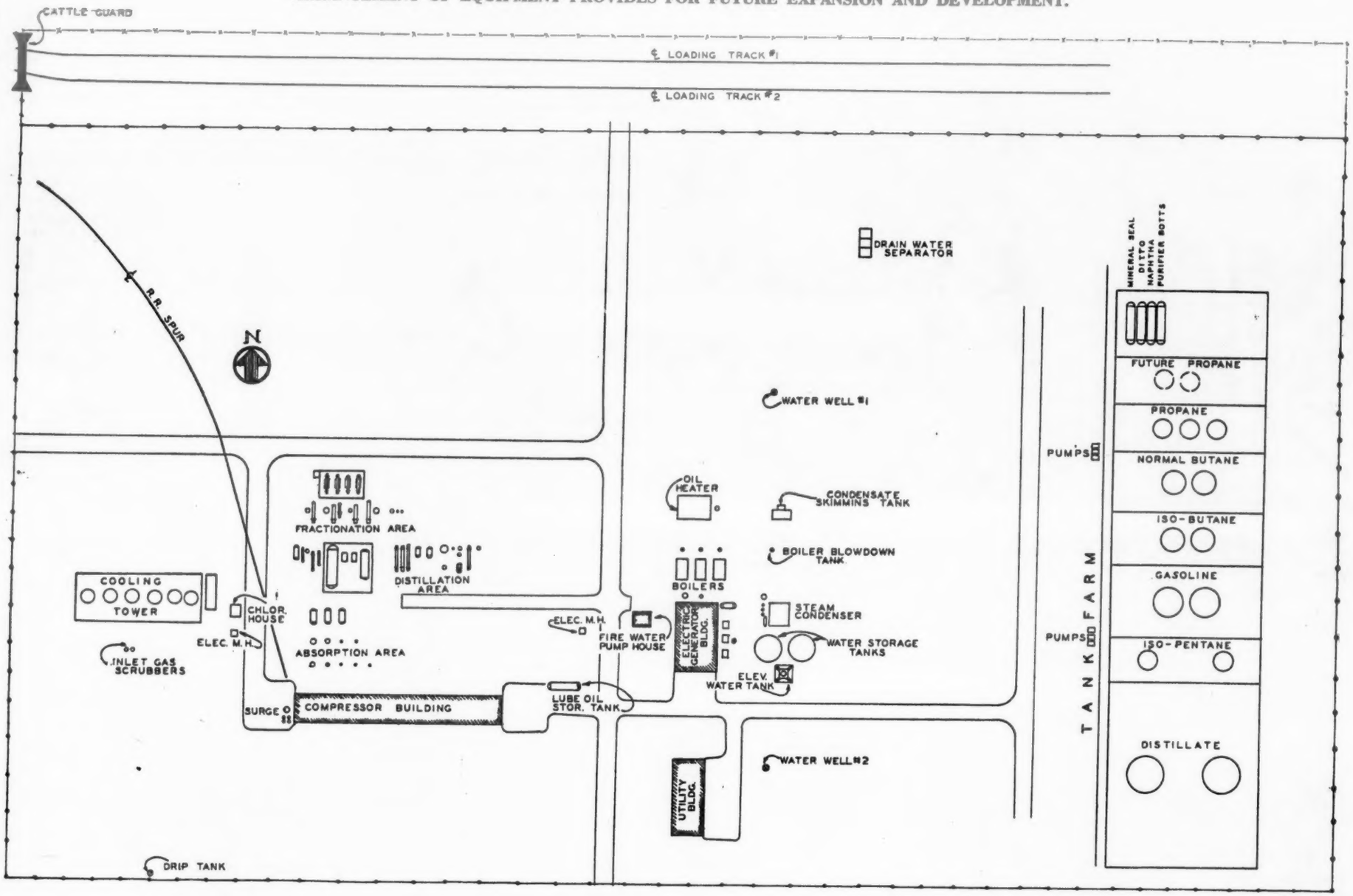
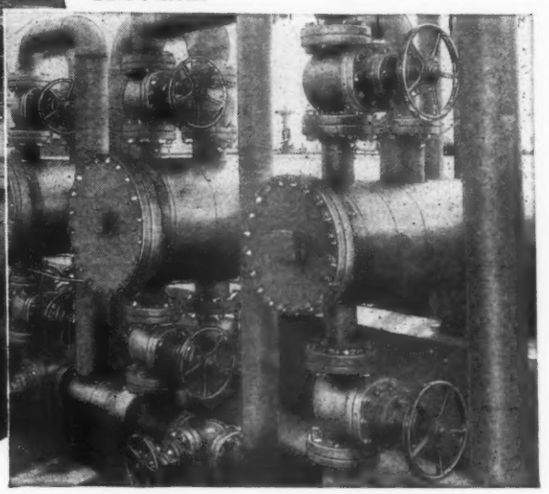


CENTRAL MANIFOLD in Tank Farm Piping, equipped with Crane Fittings and Crane Standard Iron Body Double Disc Gate Valves.

HEAT EXCHANGER BANK in a Recycling and Reprocessing Plant, showing Crane 250 lb. Ferrosteel Wedge Gate Valves.



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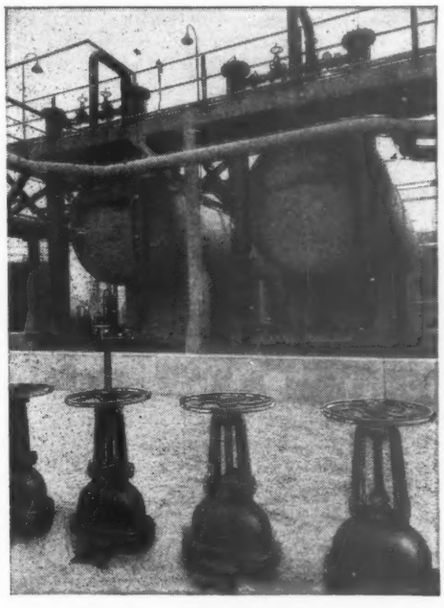

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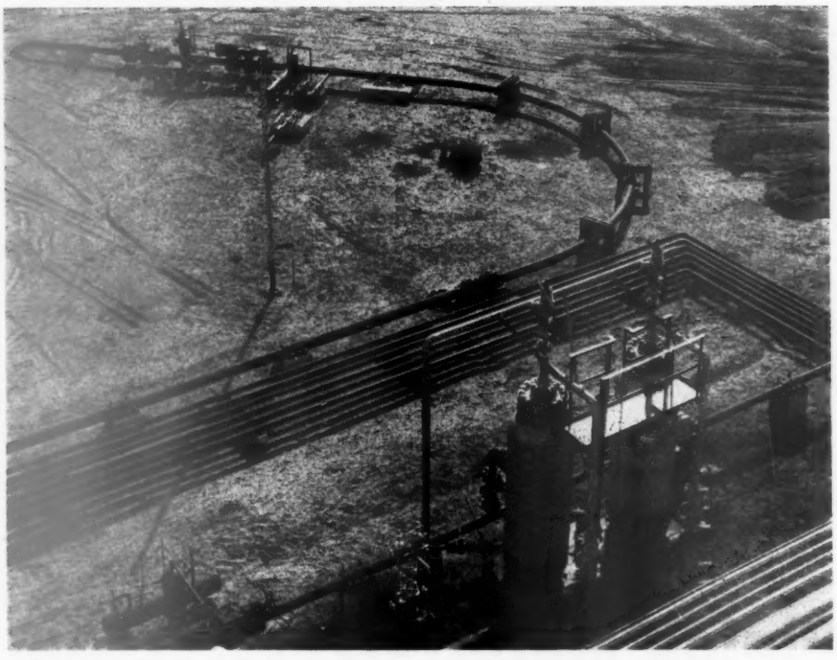

Inlet scrubbers and injection line with expansion bend. Piston operated plug valves provide instant shutdown control for gas system.

43,900 gal. of rich oil per hr. Final temperature through the heater is 470°F.

The resultant hot liquid-vapor mixture, containing nearly 5 per cent vapor by weight, is separated from the liquid in a 48-in. by 8-ft., horizontal, fifth-stage flash tank. The overhead vapors join vapors of fourth-stage flash tank to enter the fractionating still.

A portion of the vented hot rich oil from the fifth-stage flash tank at 470°F. and 80 lb. per sq. in. enters the tube bundle of the 72-in. by 16-ft. upright oil conditioner to heat absorption oil preparatory to reconditioning. Another and smaller portion of this same rich oil is fed into the shell side of the oil conditioner along with 65 lb. per sq. in. process steam that promotes vaporization of the light ends of the oil as a result of the added heat and steam. Oil conditioner overhead is fed to the bottom of the fractionating still as rich oil stripping medium. Bottom product of the oil conditioner is drained to burn pit.

A third hot rich oil stream enters the distillate reheater for heating the base of the distillate stripper after which it enters the fractionating still at about the eighth tray from the bottom.

Distillate from the bottom outlet of the distillate stripper is heated on the tube side of the distillate reheater and ejected to the top of the 36-in. diam. by 11-ft. reheater by process steam entering the base at 65 lb. per sq. in. and traveling at relatively high velocity upward through the tubes. The mixture of steam and distillate re-enters the 36-in. diam. by 38-ft., 15-tray distillate stripper. Overhead vapors from the distillate stripper enter a side inlet to the fractionating still.

Stable distillate is drawn from the bottom of the stripper at 425°F. and the heat utilized to warm up incoming raw distillate in 3 heat exchangers before going to lean oil surge tank or to storage.

The 96-in. diam. by 69-ft. 6-in., 27-tray fractionating still operates at 65 lb. per sq. in. with a bottom temperature of approximataely 425°F. and a top temperature of about 200°F. Top product is cooled to 160°F. in 6 still primary condensers arranged in 3 parallel banks of 2 condensers each. A 60-in. by 10-ft. still reflux tank receives the cooled liquid, a portion of which is recycled in its cooled condition for reflux over the top of the still. The remainder is cooled to 90°F. in 8 water-cooled gasoline condensers arranged in 4 parallel banks of 2 condensers each in the cooling tower. The 90°F. gasoline is collected in a 10-ft. diam. by 40-ft. horizontal gasoline run tank. Condensed water can be drawn off through a trap at the bottom. The top is vented to the recompressor scrubber where non-condensable hydrocarbons at this pressure are put back into the system at the rectifier.

Continuing with the portion of 160°F. gasoline used as reflux, a 3-in. centrifugal pump operating on a pressure differential of 35 lb. per sq. in. and driven by a 15-hp. electric motor introduces reflux at the rate of 240 to 250 gal. per min. at the top of the tower. An identical unit is used as standby.

The high-temperature bottoms are drawn off and run countercurrent to the incoming rich oil in 6 heat exchangers. Further cooling of the lean oil is accomplished in 10 oil coolers arranged in 5 parallel banks of 2 coolers each in the cooling tower. The lean oil is accumulated in the 8-ft. diam. by 30-ft. horizontal lean oil surge tank.

It is to be noted at this point that the remainder of the system operates on products drawn from the gasoline run tank, which consist of raw gasoline from the bottom and non-condensable hydrocarbons drawn from the top of the tank and recompressed to the rectifier.

● **Fractionation.** A 42-in-diam. by 53-ft. 6-in. 30-tray rectifier operating at a pressure of 450 lb. per sq. in. receives its charge from the gasoline run tank after the 90°F. liquid has received a boost in pressure from 60 lb. per sq. in. to tower pressure by the 18-in. by 8½-in. by 18-in. horizontal simplex steam pump capable of delivering 100 gal. per min. at a differential pressure of 410 lb. per sq. in. Three identical pumping units are connected to the charging line and manifolded in such a manner that one is used for charging pump, a second for reflux to the top of the rectifier, and a third as spare for either charging or refluxing duty.

The charge receives heat from 2 sources before entering the rectifier; first from heat interchange with pentane fractionator bottoms and second from heat interchange with rectifier bottoms.

This gives the charge to rectifier a temperature of approximately 220°F. when it is joined with recompressed gaseous hydrocarbons at approximately the same temperature and pressure as it enters the rectifier against a pressure of 450 lb. per sq. in.

Additional bottom heat to the rectifier is supplied by a rectifier reheater using 200 lb. per sq. in. steam. Bottoms are collected in the rectifier bottoms tank to be cooled in the rectifier bottoms exchanger before going to the depropanizer.

Rectifier overhead is condensed and cooled from 135°F. to 100°F. in two rectifier reflux condensers situated in the cooling tower and is finally collected in the rectifier reflux tank for further use as reflux. A portion of vented vapors from the reflux tank are used for boiler and heater fuel. Excess gas is passed to the second-stage booster scrubber for further recompression and injection in the field.

● **Depropanizer.** Charge to the 54-in. by 62-ft. 6-in. 36-tray depropanizer is introduced at mid-tower at the rate of 110 to 120 gal. per min. and 242°F. against a tower pressure of 235 lb. per sq. in. Depropanizer reboil heat is supplied by 200 lb. per sq. in. steam. Overhead tower vapors are condensed in 2 shell-and-tube condensers.

Once collected in the depropanizer reflux tank, liquid propane is drawn off as needed for reflux with the bulk of the liquid going through a single propane cooler at the cooling tower to lower its temperature from 122°F. to approximately 90°F. and then to storage.

The 2 depropanizer reflux pumps, one on stream and the second a standby, are 10-in. by 10-in. by 18-in. simplex steam pumps operating on 200-lb. per sq. in. steam delivering 150 gal. per min. against a differential pressure of 35 lb. per sq. in.

● **Debutanizer.** Feed to the debutanizer is taken from the bottom of the depropanizer reboiler at the rate of 90 to 105 gal. per min. and 280°F., being in-

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troduced about mid-column. The 72-in. diam. by 72 ft. 6-in. 40-tray debutanizer is maintained at a pressure of 125 lb. per sq. in. with reboil heat being supplied by 200 lb. per sq. in. steam.

Debutanizer overhead is condensed in the 2 shell-and-tube reflux condensers, the overhead attaining a final temperature of 160°F. before passing to the debutanizer reflux tank. A portion is employed as reflux and is pumped by a 3-in. centrifugal pump delivering 322 gal. per min. against a differential pressure of 55 lb. per sq. in. A 20-hp. electric motor drives the reflux pump.

● **Butane fractionator.** A 60-in. diam. by 130 ft. 70-tray butane fractionation tower is employed for the separation of the butane isomers. Feed is introduced from the debutanizer reboiler to the column at a choice of points from the 31st to the 39th trays, depending on desired operating conditions. Reboil heat is supplied by 5 lb. per sq. in. steam.

Normal butane from the bottom of the tower passes to the normal butane coolers consisting of 2 units in series, which reduce the temperature from 155°F. to 90°F. It passes finally to pressure storage.

Isobutane, as overhead at 131°F., is condensed in 2 shell-and-tube condensers, and is finally collected in the fractionator reflux tank. A portion of the liquid is pumped to the tower as reflux by a 2-in. centrifugal pump delivering isobutane at a rate of 252 gal. per min. and at a differential pressure of 72 lb. per sq. in. The pump is driven by a 20-hp. electric motor. An identical unit is employed as standby. Isobutane production passes through 2 isobutane coolers situated in the cooling tower and finally to pressure storage tanks.

● **Pentane fractionator.** Debutanizer bottoms are fed to the 84-in. diam. by 130 ft. 70-tray pentane fractionator at a rate of 50 to 65 gal. per min. through a water-cooled pre-cooler that reduces the temperature of the feed from 305°F. to 215°F. Fractionator pressure is maintained at approximately 35 lb. per sq. in. and the charge is introduced to the column from the 31st to the 39th trays, depending on desired operating conditions. Reboil heat is supplied by 65 lb. per sq. in. process steam.

The bottoms from the tower, which is isopentane-free gasoline, exchange heat with the raw gasoline charge to the rectifier and pass through final coolers before reaching storage.

The overhead from the pentane fractionator is commercially pure isopentane at a temperature of 155°F., which is condensed in 2 shell-and-tube condensers. The overhead condensate is collected in the reflux tank where a portion is returned to the column as reflux by a 307 gal. per min. 2-in. centrifugal pump operating against a differential pressure of 75 lb. per sq. in. The remainder is routed through 2 coolers where its temperature is reduced to 90°F. and then to pressure storage.

Compressor pressure cylinder gland connections, second and third-stage booster scrubbers, the recompressor scrubber, lean oil surge tank, depropanizer reflux tank, debutanizer reflux tank, butane fractionator reflux tank, and vent line from the loading rack are all connected to an 8-in emergency flare line. First-stage booster scrubber and rectifier reflux tank are vented to a 10-in flare. For emergency relief of the entire high pressure absorption area, the high pressure cylinders of the compressors, inlet gas scrubbers, incoming and outgoing gas lines from the field have been connected to a 12-in. flare. All 3 flares may be by-passed to the burn pit and are situated 800 ft. north of the plant fence. A 2-in. line from the oil conditioner to the waste pit is heavily anchored and contains 2 expansion loops to allow for the sudden rise in temperature when the line is operated intermittently.

Fractionating towers and processing equipment are grouped conveniently.

● **Tank storage.** Twenty tanks in the 2.25 acre tank farm handle processing and delivery storage for plant products.

Four 9-ft. diam. by 35-ft. horizontal welded steel tanks are used for mineral seal oil (two tanks), naphtha, and purifier bottoms. Three 6-ft. diam. by 30-ft. horizontal welded tanks with working pressures ranging from 125 to 200 lb. per sq. in. are used for LPG products.

Two 7500-bbl. 36-ft. diam. by 42-ft. upright welded steel tanks are used for distillate storage. Two 2500-bbl. 30-ft. diam. steel spheroid tanks on earth foundation contain natural gasoline at a working pressure of 15 lb. per sq. in. Four 1500-bbl. 25-ft. 3-in. diam. steel spheres handle isobutane and normal butane at a working pressure of 75 lb. per sq. in. The 4 tanks are mounted on 6 upright steel columns. Two 1250-bbl. 19-ft. 6-in. diam. by 24-ft. hemispheres at a working pressure of 10 lb. per sq. in. store isopentane. Three 1000-bbl. 22-ft.

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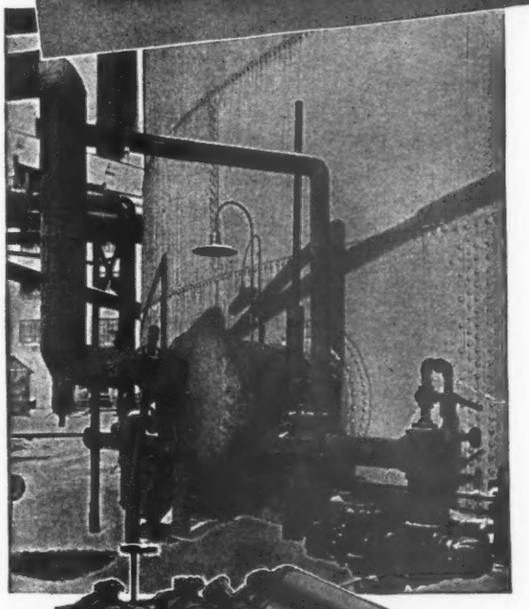
WITH Vogt UNIT TANK HEATERS*



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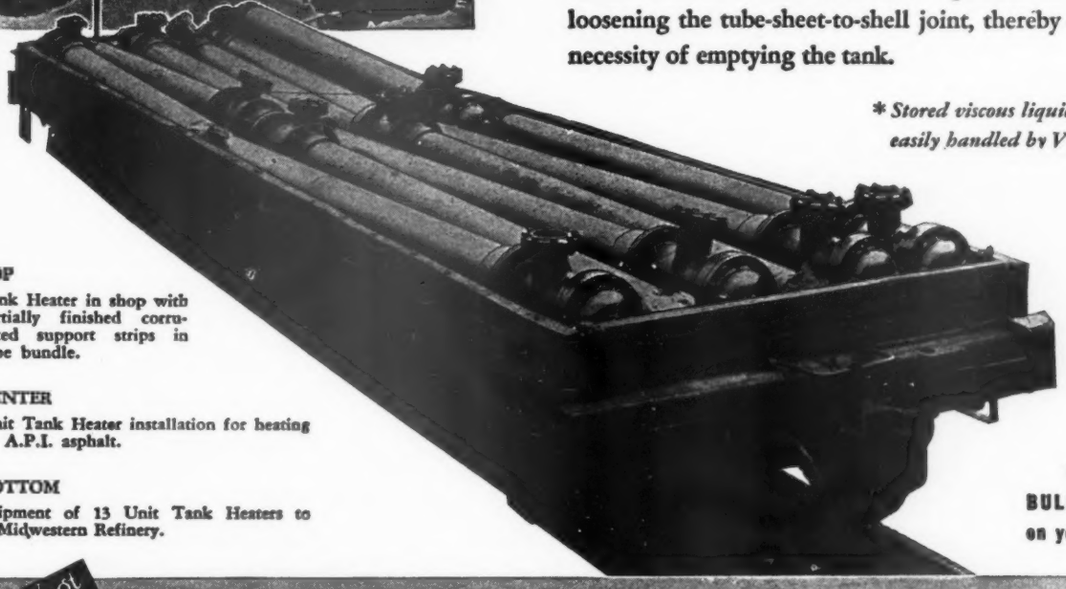

TOP
Tank Heater in shop with partially finished corrugated support strips in tube bundle.

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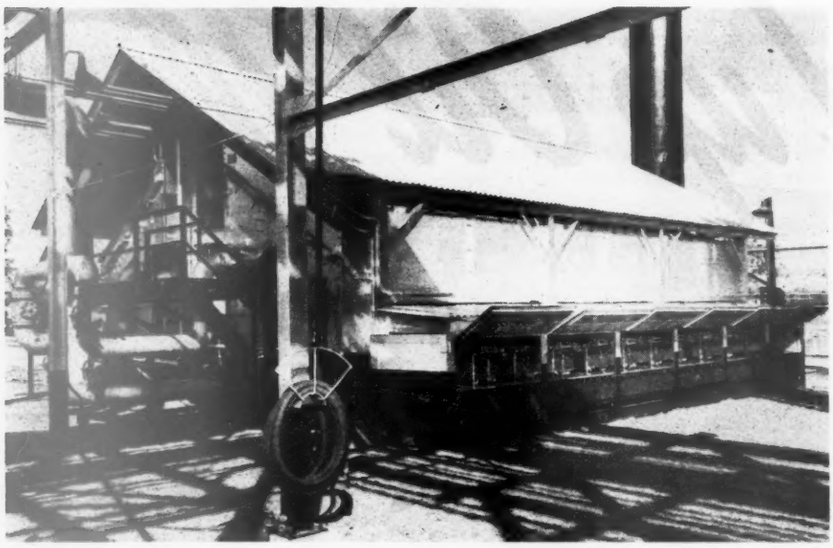


Direct-fired absorption oil heater.

3-in. diam. spheres hold propane at a working pressure of 200 lb. per sq. in. and are supported by 6 upright steel columns.

All upright tanks have spiral stairways for the full length of the tank. Spherical tanks have spiral runs from top to equator and straight runs below the equator.

Loading pumps are situated outside the storage firewall and are either steam or electrically driven reciprocating or centrifugal pumps as shown in Table 3.

● **Loading rack.** An 807-ft. prefabricated steel loading rack 12 ft. 6 in. above grade serves the double-track tank car spur. The loading rack is mounted on concrete piers and provides an unobstructed walkway of 3 ft. 10 in. A maximum of 42 tank cars may be filled simultaneously.

● **Water supply.** Two water wells 250-ft. deep can supply more than a million gallons per day to the plant.

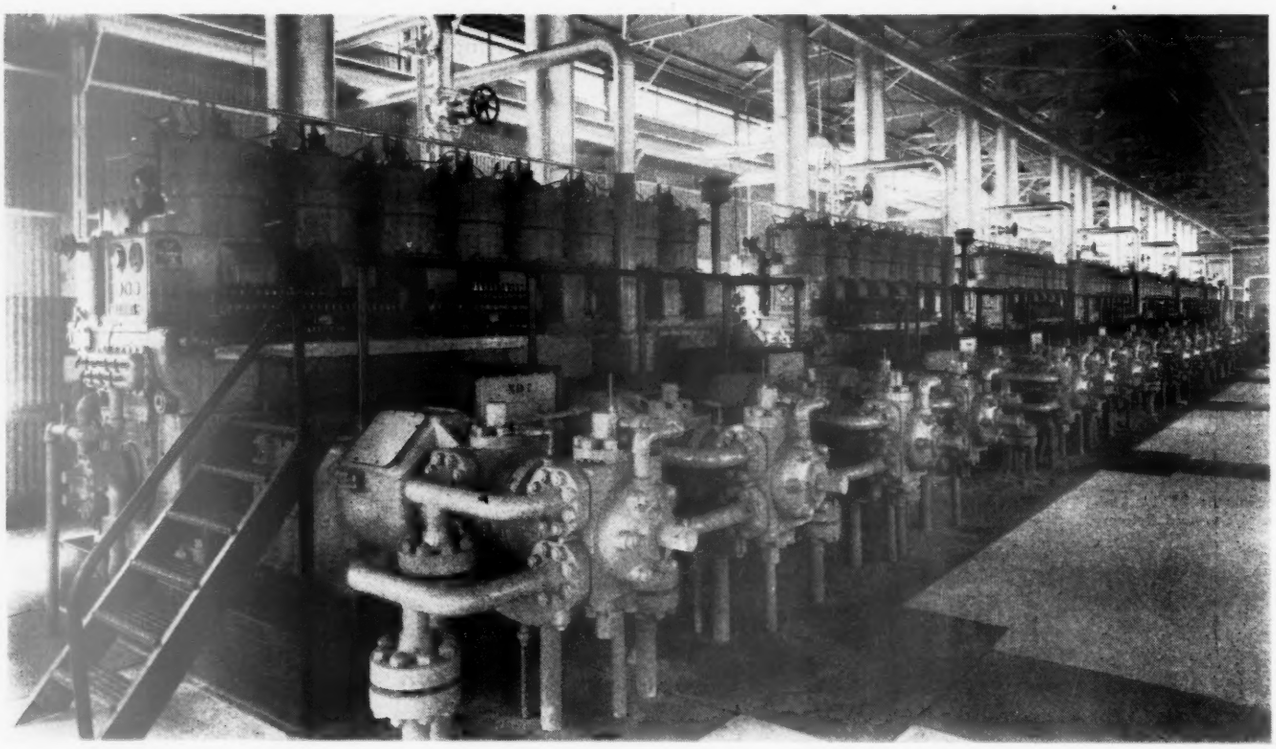
A 10-in. 6-stage deep-well turbine pump driven by gas turbine delivers 500 gal. per min. to the 8400-gal. water tank elevated 30 ft. above the ground. The 45-hp. single-stage turbine operates on 250-lb. per sq. in. residue gas reducing it to boiler and heater fuel system demand pressure of 25 lb. per sq. in. A steam jacket on the gas line entering the turbine prevents freezing of the turbine exhaust. The second well pump is identical except for the prime mover, which is a 50-hp., 220-volt electric motor. Sand filters are placed in the line between the wells and elevated tank.

Overflow from the elevated tank fills two 84,000-gal. storage tanks from which an 8-in. suction to the plant fire pump assures adequate water for fire fighting. The fire pump is a single-stage 4-in. centrifugal pump rated at 750 gal. per min. against a pressure of 125 lb. per sq. in. and is driven by an 80-hp. turbine operating on 200 lb. per sq. in. steam. Buried 6-in. fire water lines throughout the plant supply the 16 fire plugs with a 4-in. branch going to the 2 camps. Service water lines are also 6-in. in the plant and 4-in. to the camps.

● **Cooling water.** The 53-ft. 6-in. by 136-ft. 9-in. by 55-ft. induced draft cooling tower consists of 6 cells in 2 sections separated by a partition from foundation to top. Four electrically driven fans induce draft through 4 of the 6 cells cooling water for the open-coil section of the tower, which is designed to dissipate 78,695,000 B.t.u. per hr. This requires the circulation of 8500 gal. per min. of water at 101½°F. over the top of the tower resulting in a collector basin temperature of 85°F. In this section 62 atmospheric sections are arranged above the basin in 41 stacks. The tower has been designed to withstand a 120 mi. per hr. wind.

The shell-and-tube section of tower is designed to remove 42,900,000 B.t.u. per hr., at a water circulation rate of 3300 gal. per min. and a range of 116°F. to 90°F. This water is piped in 12-in. mains to the shell-and-tube condensers in the fractionator area. A 3-in. branch line carries generator engine oil cooling water. A 6-in. branch carries cooling water to the compressor engine oil coolers and compressor cylinder jackets.

Seven 800-hp. angle-type compressors are used to recompress and inject dry gas in the gas cycle.



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Aerial view shows tank farm.

Two single-stage 12-in. vertical pumps circulate cooling tower basin water over the tower, as well as a side stream over the still reflux condensers. Each pump discharges into a 20-in. diam. header that tapers to 14 in. as it runs the length of the cooling tower; 12-in. risers feed the overhead spray sections. The pumps are driven by 75-hp. 440-volt electric motors. A third pump serves as standby.

The shell-and-tube section of the tower is served by a 2 stage 16-in. sump turbine pump with identical spare capable of delivering 3800 gal. per min. against a pressure of 40.5 lb. per sq. in. and driven by a 100-hp. 440-volt electric motor. A condenser water filter is placed in the discharge line for the purpose of filtering water ahead of the shell-and-tube coolers and condensers.

The tower is supplied make-up water by a 6-in. line from the plant water service system. A chlorination unit treats all cooling water for the prevention of algae growth.

The compressor engine power cylinder jacket water system consists of 6 atmospheric sections in the cooling tower coil shed, fed through 12-in. mains from the compressor building. Cooling water circulation is maintained by a 12-in. centrifugal pump rated at 4000 gal. per min. against a differential pressure of 28 lb. per sq. in. The pump is electrically driven by a 100-hp. 440-volt motor at 1150 r.p.m. Two units are used, one for standby purposes.

Engine jacket water for the 3 generator prime movers is handled in the same manner except 2 atmospheric sections are used in the cooling tower. The mains are 10-in. and the pump is a 5-in. centrifugal delivering 1200 gal. per min. against a differential pressure of 28 lb. per sq. in. A 30-hp. 440-volt electric motor provides the necessary power.

● **Electrical power plant.** Three 880-hp. 4-cycle 8-cylinder gas engines with 15-in. bore and 17½ in stroke operating at 360 r.p.m. drive 3 direct-connected, 555 kw., 3-phase, 60-cycle, 480-volt generators. The generators have a power factor of 0 8. The d-c. exciter is rated at 15-kw., 125-volts and is direct-connected to the engine. Electrical load on the generators with full plant operation will be approximately 75 per cent of full load on 2 units. Under normal plant operation 2 units will be operated with 1 for spare.

The metal-enclosed switchboard contains the combined switchgear for all 3 generators. Transformers reduce the line voltage from 440 when necessary and are of the dry type, 3-phase, delta wound to 120/208 volts. All wiring and fixtures in hazardous areas are explosion-proof. All conductors underground and exposed to weather are lead covered.

● **Steam system.** Three sterling type, water tube boilers rated at 500 hp. and 35,000 lb. per hr. each, supply 200 lb. per sq. in. steam to the plant. The boilers are gas fired and are equipped with turbine-driven, induced draft fans in the 36-ft. stacks. Feed water is introduced to the boilers by two 2-in. single-stage centrifugal pumps that deliver 140 gal. per min. against a pressure differential of 225 lb. per sq. in. One pump is operated by a 50-hp. 440-volt electric motor, whereas the other is driven by a 35.4-hp. steam turbine on 200 lb. sq. in. steam. A 48-in. diam. by 9-ft. vertical blowdown tank is provided for the 3 boilers. The feed water heater consists of a 60-in. diam. by 15-ft. vertical vessel containing 3 trays and utilizes 5-lb. per sq. in. exhaust steam as the heating medium.

A 12-in. steam line delivers 70,000 lb. per hr. of steam at 200 lb. per sq. in. to the process area from the boilers. A 4-in. branch line supplies the fractionating pump building; another 4-in. branch delivers snuffing steam to the rich oil heater.

The 65 lb. per sq. in. steam exhaust of the outboard turbines driving the 2 high pressure lean oil pumps is used for open stripping steam in the still and for heating the pentane fractionator reboiler. There is also sufficient quantity exhaust steam from these 2 turbines to reduce to 15 lb. per sq. in. for utility heating purposes throughout the plant. Utilized in this manner it is not necessary to install pressure reducing valves merely for low-pressure processing steam, in which case the potential power of the steam would be wasted.

Two 4-in. condensate return lines, one by gravity to the skimming tank from the deisobutanizer reboiler and the other at 34 lb. per sq. in. to the condensate receiver, collect condensed steam in the distillation and fractionation areas.

The 5 lb. per sq. in. exhaust steam not employed in reboiling the butane fractionator is returned in a 12-in. exhaust header to a low-pressure steam condenser. The forced draft low-pressure steam condenser is a 2-cell steel frame supporting 3 finned tube atmospheric cooling sections containing 20,520 sq. ft. of cooling surface. The 11-ft. diam. fans at the base of the framework deliver 302,000 cu. ft. of air per min., removing approximately 19,280,000 B.t.u. per hr. from the 5-lb. per sq. in. exhaust steam. The unit is enclosed by sheet metal and is designed to condense 20,000 lb. of steam per hr. One fan is driven by a 25-hp. 440-volt electric motor, whereas the second is operated by a 25-hp. steam turbine on 200-lb. per sq. in. steam. Both are driven through reduction gears resulting in a fan speed of

TABLE 3

Duty	Type	Size	Capacity, gal. per min.	Motive power	Rating, hp.
1. Gasoline loading	Centrifugal	3-in.	320	Electric motor	7.5
2. Distillate loading	Centrifugal	3 in.	320	Electric motor	7 5
3. Isopentane loading	Centrifugal	2 in.	80	Electric motor	3 0
4. Isobutane loading	Centrifugal	2 in.	80	Electric motor	3.0
5. Butane loading	Centrifugal	2 in.	175	Electric motor	3.0
6. Truck loading	Reciprocating	6 in. x 5 in. x 12 in.	240	Steam	7.5
7. Propane loading	Reciprocating	8 in. x 7 in. x 18 in.	32	Steam	..
8. Distillate rerun *Reconditioned.	Reciprocating	10 in x 3½ in. x 12 in.	*	Steam	..

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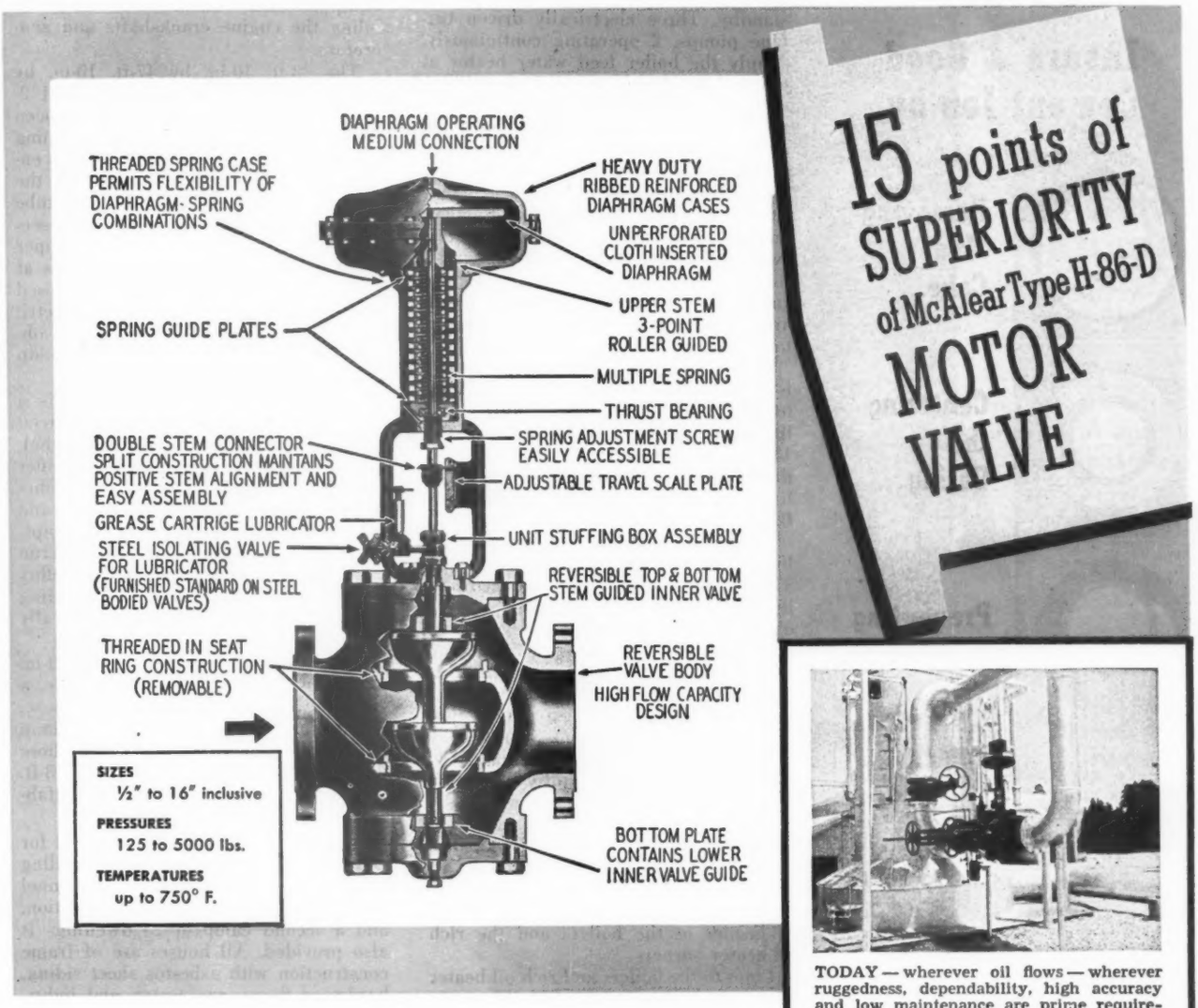
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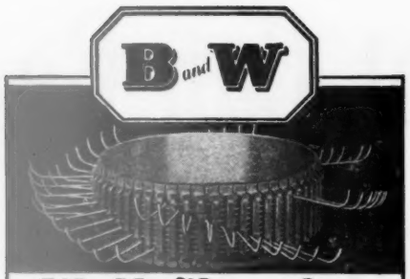

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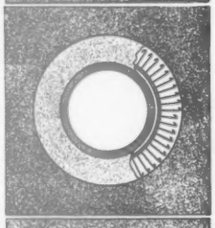

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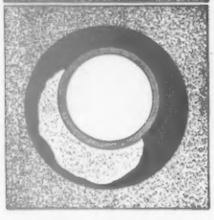

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1750 r.p.m. An 8-ft. diam. by 14-ft. horizontal condensate accumulator collects condensate from the 3 coolers.

All condensate returned under low pressure from various plant equipment is eventually collected in an 8-ft. diam. by 14-ft. horizontal condensate receiver supplying a centrifugal boiler feed pump previously described.

Steam condensate from the butane fractionator at 5 lb. per sq. in. and raw makeup water are handled by a 60 gal. per min. 10-stage turbine pump at a differential pressure of 60 lb. per sq. in. and driven by a 3-hp. 220-volt electric motor. There is also an identical unit for standby. Three electrically driven turbine pumps, 2 operating continuously, supply the boiler feed water heater at the rate of 50 gal. per min. at a differential pressure of 20 lb. per sq. in.

● **Fuel system.** Reabsorber residue gas is employed for fuel, giving preference to the compressor and generator engines. Should there be insufficient quantity of fuel from this source for boilers and the oil heater, makeup to the latter system is automatically maintained by the use of rectifier reflux vapors. Vented vapors from the rectifier reflux tank that are not required for fuel are returned to the injection wells.

A 6-in. gas line to the 7 compressors is reduced from 440 lb. per sq. in., then to 75 lb. per sq. in., and finally to 35 lb. per sq. in. after which it enters the 15-in. diam. fuel gas reservoir running the length of the compressor house. The line is designed to supply 1,350,000 cu. ft. per day to the engines.

A 4-in. branch of the 75 lb. per sq. in. line carries 576,000 cu. ft. per day to the 3 generator engines and is reduced to 1 lb. per sq. in. before entering the 16-in. diam. by 12-ft. fuel volume tank placed at each engine. The 75 lb. per sq. in. main also supplies two 3-in. domestic fuel lines to the 2 camps.

Fuel to boilers, oil heater, and other uses in the utility section is supplied by a 3-in. 250 lb. per sq. in. line from the gas absorption area. Useful work is first obtained from the high-pressure gas by expanding it through the water-well pump gas turbine drive, which exhausts at 25 lb. per sq. in. A drip tank removes condensate after which the gas is piped through a 4-in. line to the burner header of the boilers and the rich oil heater burners.

Lines to the boilers and rich oil heater have a fuel capacity of 2,200,000 cu. ft. per day and 1,000,000 cu. ft. per day, respectively.

● **Engine starting air.** Two 6½-in. by 3½-in. by 4-in. 250 lb. per sq. in., 27 cu. ft. per min., 2-stage, angle-type, air-cooled compressors, one driven by an electric motor and the other by gasoline engine, together with four 24-in. diam. by 12-ft. vertical air bottles, are placed at the west end of the compressor house. A 3-in. line to the compressor power cylinders supplies 250 lb. per sq. in. air for starting. The compressors also supply starting air to the generator engines by means of a 2-in. line to 2 air bottles situated outside the generator building.

A small portion of the air is reduced to 150 lb. per sq. in. by regulator and piped throughout the plant as utility air.

● **Buildings.** The compressors and starting-air equipment are housed in a 30-ft. 5½-in. by 216-ft. 1-in. by 18-ft. prefabricated corrugated sheet iron building on concrete foundation. Two overhead 8-in. 13-lb. I-beams act as track supports for the 11-ft. bridge beam supporting the 2000-lb. capacity hoist.

The generator building enclosing the 3 generators and switchgear is a 48-ft. 5½-in. by 72-ft. 1-in. by 18-ft. prefabricated corrugated sheet iron building equipped with overhead monorail paralleling the engine crankshafts and generators.

The 28-ft. 10-in. by 47-ft. 10-in. by 26-ft. reinforced concrete and steel 2-story fractionating pump house has been especially designed to house pumping equipment on the first floor, which is enclosed by hollow tile, reflux tanks on the open second story, and shell-and-tube condensers on the open roof of the second story. Ready access to the upper levels are provided 2 steel staircases at both ends of the building. The enclosed first floor is equipped with an electrically driven exhaust fan to remove objectionable heat and vapors from pump gland leaks.

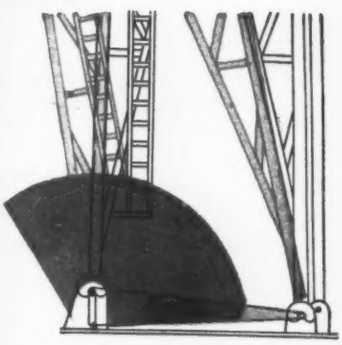
The distillation pump building is a 51-ft. by 52-ft. 3-in. by 15-ft. reinforced concrete steel structure enclosed by hollow tile. The first floor houses 3 rectifier charge and reflux pumps, 2 still reflux pumps, 2 reabsorber lean oil pumps, and 2 high pressure absorber lean oil pumps. The roof space supports the gasoline run tank, lean oil surge tank, rectifier reflux tank, and still reflux tank. The building is also provided with an electrically driven exhaust fan.

Other housing includes a 36-ft. 9-in. by 80-ft. 2-in. by 14-ft. utility house, a 16-ft. by 16-ft. by 8-ft. chlorinator house, a 16-ft. by 26-ft. by 8-ft. fire water pump house, a 16-ft. by 16-ft. by 8-ft. hose house, and a 12-ft. by 14-ft. by 8-ft. loading foreman's house, all of prefabricated corrugated sheet iron.

● **Camps.** Two camps are provided for employes of the plant. A 10-dwelling camp for staff and supervisory personnel is situated close to the plant location, and a second camp of 25 dwellings is also provided. All houses are of frame construction with asbestos sheet siding, hardwood floors, gas, water, and lights. Sizes range from 4 to 5 rooms with a garage for each unit.

● **Contractor and company supervisor.** Petroleum Engineering, Inc., Houston, Texas, was the designated engineer and contractor by Shell with the task of design, drafting, engineering, and construction of the entire plant from specifications provided by Shell and under Shell supervision. The Gas-Gasoline Department of Shell's Texas Gulf area is under the direction of T. R. Goebel, manager, and M. R. Church, assistant manager. Representing the company in design and initial operation of the plant was J. T. Jordan, Shell process engineer. ★ ★ ★

G-500 DRILLING RIG
with PORTABLE MAST



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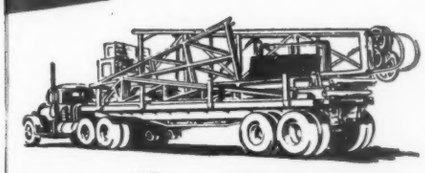
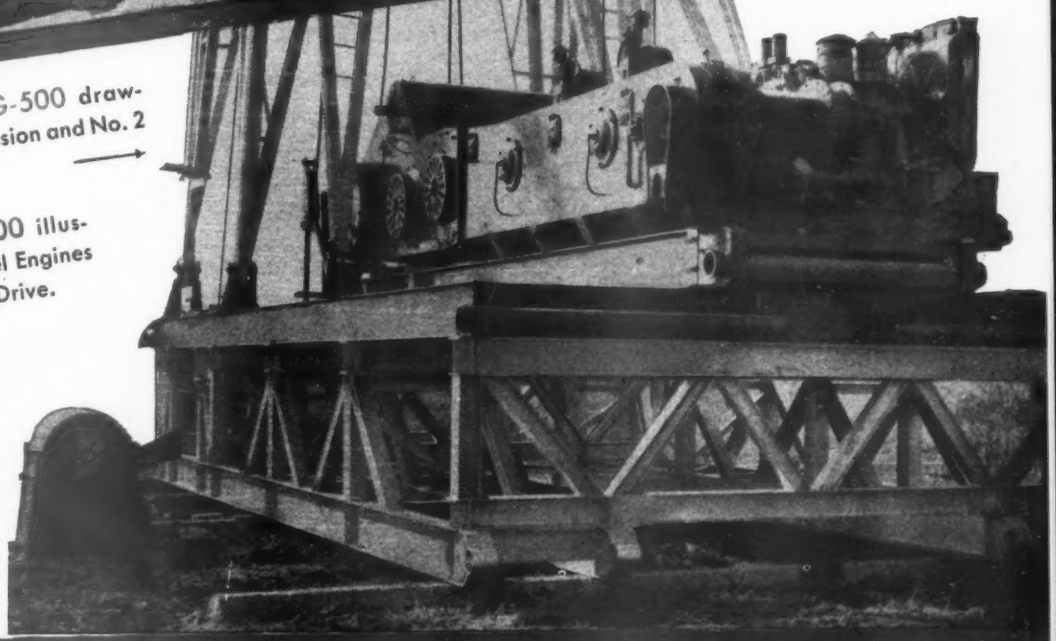
Right: Side view showing G-500 drawworks, Compounding Transmission and No. 2 Engine. →

Left: Side and rear view of G-500 illustrating G-M Series 71 Twin 6 Diesel Engines and Fawick Air-Flex Clutch Pump Drive. ←





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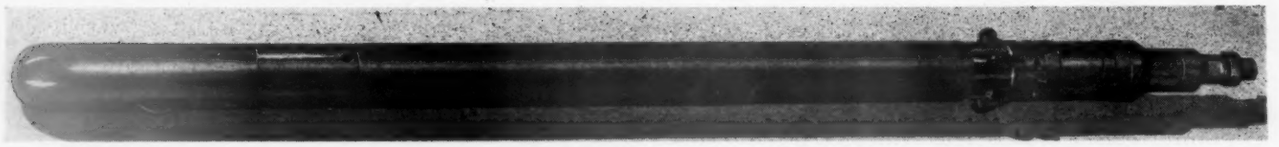


FIG. 1. Side view tubing caliper.

INTERNAL TUBING CALIPER*

By **PRESTON E. CHANEY,** Sun Oil Company

THE problem of internal corrosion in the tubing and wellhead fittings of gas-condensate wells has become a matter of great importance to the gas-producing industry.

In recent years, corrosion has been responsible for the failure of numerous tubing strings, and in a few cases has caused complete loss of the well.

The appearance of this new corrosion problem suggested the need for some means of measuring the extent and location of corrosion damage in gas well tubing that did not involve killing the well and pulling the tubing for a surface inspection. Work undertaken in the Sun Oil Company's Beaumont division laboratories, toward the development of a tool for this purpose has led to production of Chaney-Barnes tubing caliper[1].

This caliper is entirely mechanical, and is adapted to be run into the tubing on a measuring line, using equipment similar to that required for bottom hole pressure and sampling operations.

● **Calipering mechanism.** Referring to Fig. I, just below the fishing neck and swivel is the calipering mechanism proper. Calipering is accomplished by means of 6 or more independently operating lever arms, to the outer end of which are attached small wheels or rollers to contact the tubing wall. Each lever arm is provided with a spring to urge the feeler wheel outwardly against the tubing wall. The inner arms of the 6 levers contact a polished steel plate on the end of the stylus rod, and it may be seen that the stylus is driven downward whenever any one of the feeler wheels moves outwardly into a pit. In the event that there are several pits of varying depth about a single cross-section of the tubing wall, the stylus will be actuated by the 1 feeler arm corresponding to the deepest penetration of the tubing wall and will be lifted free of the other 5 arms. The caliper might be considered pessimistic in this respect, as it shows the minimum wall thickness at any point traversed rather than the average wall thickness at that point; however, this is an advantage rather than a disadvantage, because the safety of the tubing with respect to pressure is determined by the minimum wall thickness and not by the average wall thickness of the pipe.

● **Centering mechanism.** In order that the caliper may function properly, it is essential that it be centered with respect to the tubing. Centering is accomplished by means of the spring loaded centering plug, which contacts the inner arms of the feeler levers on the side opposite to the stylus mechanism. This plug is carefully ground so as to contact all the lever arms simultaneously when the instrument is properly centered in a smooth walled tube. In pitted tubing, if one lever arm moves outwardly into a pit, that lever will no longer contact the centering plug; however, the 5 remaining lever arms maintain contact with the plug, and serve to center the device accurately, while the sixth arm actuates stylus to record maximum pit depth.

● **Chart drive and recording mechanism.** With the mode of operation of the calipering mechanism in mind, we may now study the chart drive mechanism.

Near the bottom of the caliper will be found 2 wheels on opposite sides of the instrument. The lowermost of these wheels is spring loaded, and serves only to maintain contact between the upper wheel and the tubing wall.

The upper wheel is of such diameter as to center the caliper within the tubing bore when in contact with the tubing wall. This wheel rolls against the tubing wall and, through the gear train shown on Fig. I, causes rotation of the splined shaft between the top of the gear box and the bottom of the chart chamber.

The inner wall of the instrument case is threaded to receive threads on the upper end of the chart chamber so that, as the chart chamber is rotated by the movement of the instrument through the tubing, it is also caused to advance along this thread. In practice the chart, which consists of a coated sheet of metal foil, is inserted into the chart chamber, and the chamber is screwed into the case until the bottom of the chart chamber contacts the stop pin shown in Fig. I, just above the gear box and in the righthand wall of the outer case. With the chart chamber in this position, the instrument is assembled and run in the hole.

FIG. 2. Caliper log, noncorroded tubing.

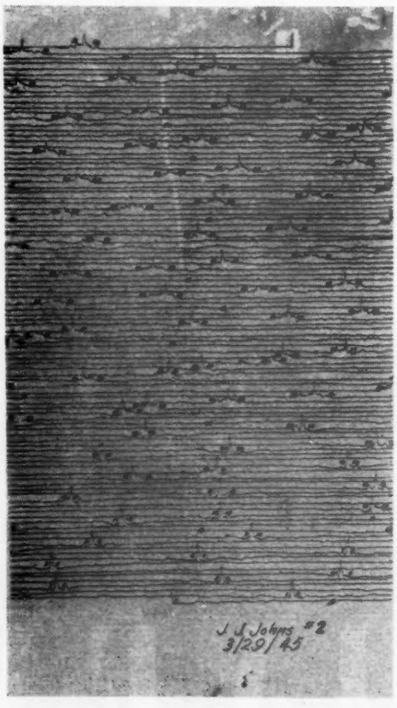
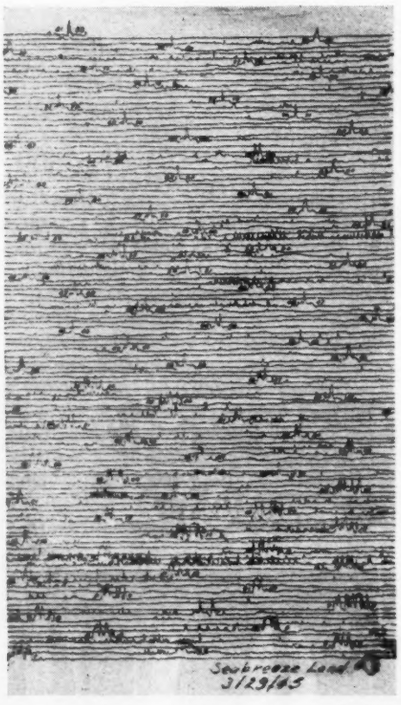


FIG. 3. Caliper log, corroded tubing.



*Presented before Natural Gasoline Association of America, Dallas, April 17-19, 1946.

[1]Through an agreement with Sun Oil Company, Otis Pressure Control, Inc., Dallas, Texas, has been granted exclusive license to provide a corrosion survey service using the new instrument, called the Otis Tubing Caliper.

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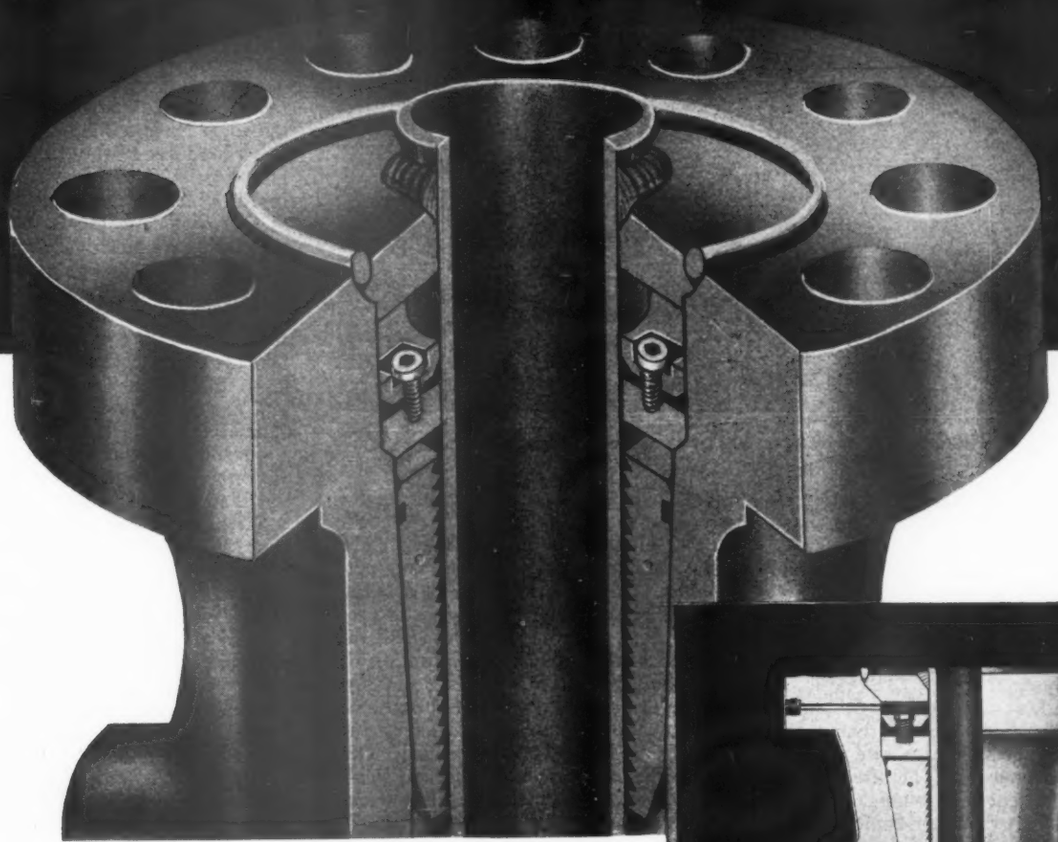

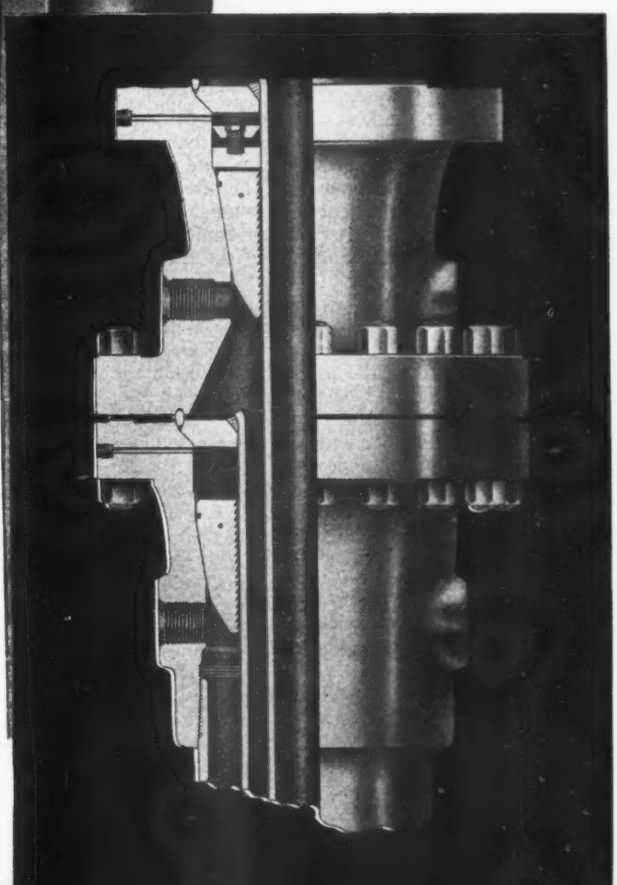

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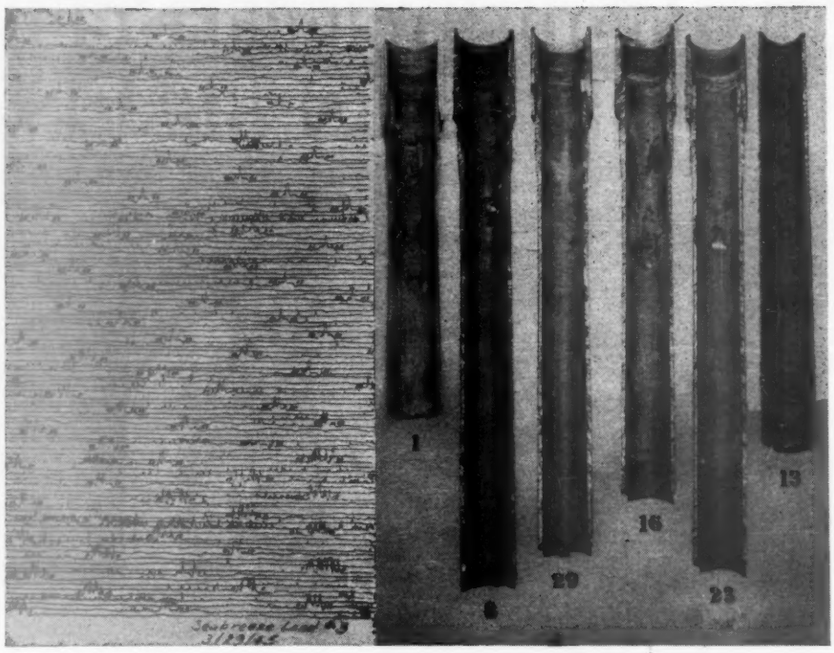


FIG. 4. Comparison of caliper log and corresponding tubing.

In going down the hole, the motion of the gear train tends to screw the chart chamber farther into the outer case, which of course is prevented by the stop pin. Hence the chart chamber does not move in going into the hole, and the ratchet mechanism shown at the bottom of the chart chamber operates to prevent locking the gear train.

When the lowest point to be calipered has been reached, the instrument is pulled out of the hole at a rate not exceeding 100 ft. per min. The direction of rotation of the gear train is now reversed, so that the chart chamber begins to rotate and to advance along the threaded connection.

Assuming a perfectly smooth walled tube, it will be seen that this motion of the chart chamber would cause the stylus to scribe a spiral line upon the chart material, corresponding in pitch to the pitch of the thread connecting the chart chamber with the outer case. This spiral, upon removing the chart for inspection, would be seen as a series of parallel lines on the chart. Any pits in the tubing wall, however, will cause longitudinal motion of the stylus, and so produce deviations from the straight and parallel nature of these lines. The magnitude of these deviations may be read directly as the depth of the deepest pit at that particular point. These charts can best be understood by reference to Figs. 2 and 3. Fig. 2 is a caliper log on a relatively new and uncorroded tubing string, while Fig. 3 is the caliper log on a severely corroded string of tubing.

● **Absence of packing glands.** There is one additional feature of this instrument that should be noted. The caliper is entirely free of packing glands. The full well pressure is freely admitted to all parts of the caliper mechanism, including the chart chamber. The chart is provided with a special oil and water resistant coating to permit logging in the presence of these fluids.

The elimination of packing glands, with their inherent frictional lag, permits the stylus to follow more closely the motions of the feeler arms, so as to provide a more accurate record of small variations in the interior configuration of the tubing wall.

Also there is no danger of collapse of the outer wall of the instrument, for pressure loading does not occur. The caliper can be run safely under any pressure for which the measuring line packing gland is safe.

TABLE I. Caliper Specifications

Tubing size	2-in. API	2½-in. API
Approximate weight of caliper	14 lb.	19 lb.
Outside diameter of case	1.66 in.	2 in.
Overall length	37 in.	38 in.
Scale of record	1-in.=7 ft. tbg.	1-in.=6 ft. tbg.
Range of single survey	2300 ft.	2300 ft.
No. of feeler wheels	6	8

(Successive runs to any desired depth)

● **Interpretation of records.** Referring to Fig. 2, which is a caliper log on a comparatively new and uncorroded tubing string, it will be observed that the chart lines are relatively straight and parallel, except of course at the tubing couplings where the feeler arms expand to their maximum limit of travel. The numbers on either side of the couplings refer to the number of the tubing joint in the well as counted from the surface.

In order to determine the average inside diameter of the tubing, it is customary to set the maximum expansion of the feeler wheels to a predetermined value slightly less than the internal diameter of the tubing couplings. With the instrument set in this manner, the peaks on the log at the collars represent a known diameter, and by a simple measurement and calculation it is possible to establish the internal diameter represented by the base line, which will be the average internal diameter of the tubing. Such measurements are required in the event that generalized erosion or corrosion of the tubing is suspected.

The interpretation of caliper logs showing corrosion pits can best be understood from a study of Fig. 3, a caliper log on a severely corroded tubing string.

The distance between the lines on the chart corresponds to a change in radius of the tubing of 0.05 in. Hence any pit that allows the chart line to advance to the adjacent line is 0.05 in. deep, or if to the second line it would be 0.10 in. deep, etc. This simple relationship permits rapid estimation in the field of the extent of corrosion damage. As a final check, the chart may be enlarged by photostating, and more accurate measurements made at the critical points.

In interpreting the results of caliper surveys, it is important to bear in mind that the depth of a pit as shown on the log is the minimum possible depth of the pit. The pit is measured by the ⅝ in. diam. feeler wheels, and not by a true point contact. Hence pits of very small diameter will be recorded at somewhat less than the true depth.

Fortunately, the deeper pits are in most cases of comparatively large diameter as a result of undercutting and erosional action, and the feeler wheels are usually able to penetrate very close to the full pit depth.

● **Comparison of caliper log with visual inspection of tubing.** The final test for any subsurface caliper is a careful comparison of the caliper log with the actual tubing pulled from the well.

At present, 3 wells surveyed with the Chaney-Barnes caliper have been worked over because of corrosion indicated by the caliper log. In each case, several joints of tubing showing severe corrosion on the caliper log were split in order to compare the pits in the tubing caliper log. In each case, the correlation was quite satisfactory.

In a report of this nature, it would not be practical to present a detailed comparison of each joint of tubing with the corresponding caliper record; however, Fig. 4 shows portions of the tubing from one of these wells with the corresponding caliper log. The numbers on the tubing photographs denote the position of the tubing joint in the well, and correspond to the joint numbers as shown on the caliper log. A comparison of the log with the tubing joints illustrated in this figure indicates the close correlation that may be expected.

● **Conclusion.** The Chaney-Barnes tubing caliper may be calibrated to measure the depth of corrosion pits, as well as the internal diameter of the tubing joint with an accuracy of ± 0.01 in.

Three wells surveyed with the caliper have been worked over because of corrosion damage indicated by the caliper survey. A visual inspection of the tubing from these wells was in close agreement with the caliper survey record in each case. ★★★

NON-DESTRUCTIVE FIELD TESTING

By **C. D. HAVENS,** Southwestern Division Manager, Magnaflux Corporation

INSPECTION of critical metal parts is a problem that has been with industry for a long time. Today, probably the most widely used method of inspection is a visual inspection performed by a painstaking and careful inspector. The object, of course, is prevention of costly service failures.

EXCLUSIVE

Unfortunately, visual inspection is not always reliable. Surface conditions that appear to be a cause for worry and possible failure, leading to rejection, may have no bearing on the service life of the article inspected. Likewise, defects that seriously weaken the piece of equipment or part being inspected, or tend to shorten its normal fatigue life may sometimes show little or no visible surface indication of the seriousness of the defect. Quite frequently parts or equipment with this type of discontinuity are returned to service where failure is inevitable.

Many aids have been developed to assist in making visual inspection more positive. Aids of a mechanical nature, electrical instruments, electronic devices, and many others have been developed to assist in determining the soundness of stressed articles. Two of the more recent developments in the "non destructive" methods of testing that are being widely used throughout the entire petroleum industry are discussed in this and subsequent installments of this series.

These two methods are known as the "Magnetic Particle Inspection Method" and the "Fluorescent Penetrant Inspection Method," respectively. This article will deal with the application of the "Magnetic Particle Inspection Method" as it now is being used in the drilling and production branches of the petroleum industry. Subsequent articles will deal with both of the above mentioned methods as applied to other branches of the petroleum field.

A consideration of the causes and histories of metal failures in equipment emphasizes the need for improved methods of inspection.

Very costly and specialized equipment plus a very great degree of knowledge and skill is required to drill wells to depths of 16,000 ft. and more. Tremendous loads are put on drilling equipment. Although relatively few holes have ever been drilled to that depth, wells of 8,000 ft. to 12,000 ft. deep are common.

One of the most expensive as well as the most frequent types of metal failure in drilling is the so called "twistoff," or parting of the drill pipe. In very few instances, however, can such drill pipe failures be classed as true twistoffs. By far the largest percentage of all drill pipe failures are directly traceable to some form of notch fatigue. The term notch fatigue is quite broad and covers such discontinuities as gouges in the pipe caused by abrasion against the wall of the hole, by tongs slipping when making up or breaking down the stands of pipe. Pipe turning in the slips or rough handling of the pipe may produce notches that lead to eventual failure. One type of very dangerous notch is that caused by corrosion, prevalent in certain fields. In these fields the notch effect of the corrosion is heightened by the corrosive atmosphere or surrounding medium in which the pipe works.

Although pipe manufacturers strive to produce drill pipe of high notch resistance through metallurgical means, it it difficult to produce any material that will withstand notches and their subsequent stress-raising effect. The sharper the notch, the greater the stress-raising effect. For this reason a tight-lipped, shallow, and even microscopic crack is far more likely to result in failure than a deeper, wider, and more rounded bottom type of notch or discontinuity. In notch fatigue, all notches eventually resolve or progress into fatigue cracks. When a true crack has been started from a notch, progression of this crack to failure is inevitable. The rate of progression is dependent on rate of loading, amount of loading, and the surrounding atmosphere. In drill pipe, it is difficult to predict the actual loading conditions and the atmosphere is conducive to rapid crack propagation, with the result that a crack of any type or size in drill pipe is so serious that the joint should be discarded.

● **Pumping equipment inspection problems.** Pumping equipment in the oil field usually refers to such items as reciprocating pumps, pumping units, tubing, sucker rods, engines, valves, fittings, and other mechanical devices.

Reciprocating parts are usually highly sensitive to notch fatigue because of direct stress reversals under operating conditions. Crankshafts, rods, gears, and other parts of engines fail from fatigue. Pump bodies, tubing, cylinders, and walking beams also fail because of fatigue. In all cases of fatigue failure, the loss of valuable production must be added to the direct cost of labor and parts used in repairing or replacing the failed parts or equipment.

● **Magnetic particle principle explained.** In order to guard against notch fatigue, some means of locating sharp notches and cracks is definitely indicated. Such means are readily provided by the Magnetic Particle Inspection

Applying Magnaflux powder through special blowers. Coils around pipe provide magnetic field, obtaining current from inspection truck.

Steam cleaning tool joints prior to inspection.

Inspectors check cracks in imperfect thread of tool joint.

method. In this method, naturally the parts to be inspected must be magnetizable, but as almost all the steels used in petroleum production are magnetic, this method is most applicable. The theory behind the process is comparitively simple, but like most simple methods, requires complete knowledge on the part of the inspector. Briefly, in performing this type of inspection, the part to be inspected is magnetized, both the direction and amount of the magnetic field being carefully controlled. When the magnetic field induced in the part crosses a crack or sharp notch at approximately a 90-deg. angle, minute magnetic poles are set up at each side of the discontinuity similar in effect to those of a horseshoe magnet. While the part is in a magnetized state, finely divided ferromagnetic particles (Magnaflux powder*) are brought into the proximity of these local poles either by blowing the powder over or dusting the powder on the part. Just as a horseshoe magnet will attract and hold nails and bits of iron and steel, so do these small local poles set up by the discontinuity attract and hold the magnaflux powder. The excess powder is blown off, leaving the powder attracted and held by the discontinuity to produce what is known as a Magnaflux Indication. The trained operator and inspector can readily interpret these indications regarding the type and seriousness of the defect they indicate. Through the use of this method, cracks so small or tight lipped as to be invisible to the eye even under magnification are readily located and even those that can be seen under close scrutiny can be found in a flash. Sometimes scratches or other marks that appear to be cracks or deep sharp-bottomed notches, through visual examination, are shown by this method to be of no consequence, thereby saving rejection of a serviceable part.

● **Inspection service at drilling rigs.** Within the past year, trucks have been designed and put into service for the purpose of making magnetic particle inspection of drill pipe, rigs, and drawworks in the field. These trucks are equipped with generating units especially designed to provide proper magnetizing current, and are equipped with steam cleaning apparatus and other facilities needed to make inspection rapid and economical. From the beginning, inspection of equipment at the drilling rig has helped to reduce the number of drill pipe failures. In Florida, for example, a driller had a succession of drill pipe failures that occurred for no apparent reason. A magnetic particle inspection showed approximately 15 per cent of his drill pipe had minute fatigue cracks occurring approximately 18 in. to 24 in. from the box or pin end of the pipe. These cracks formed a network around the pipe, extending as far as 24 in. along the pipe. The joints having cracked sections were discarded and the rest of the joints returned to service, where they subsequently drilled more than 21,000 ft. of hole without another failure. This record followed the succession of 6 failures in drilling 1200 ft. before the defective joints were discarded.

In another case, a drilling contractor in West Texas experienced 10 drill pipe failures in drilling one well to 7345 ft. Inspection of the drill pipe resulted in discarding 86 joints, because of cracks begun by corrosion pitting and notches. Following the inspection and elimination of the defective pipe, he has completed one 8000-ft. well, one 8500-ft. well, and one 7500-ft. well. No drill pipe failures have occurred since the inspection, and the fourth well at the time of this writing was more than 4000 ft. deep. All these wells are in the same area and penetrate the same formations in which the previous failures occurred.

These are case histories taken from field experience; however, it should be borne in mind that magnetic particle inspection is not a "cureall" for drill pipe troubles, for, as all drillers know, pipe will wear, corrosion will occur, and drilling accidents or difficult drilling conditions may put undue stress on the pipe and cause failure.

It is axiomatic that proper drilling weight, mud control, and many other factors have a direct relationship to drill pipe life. Although all defective joints of pipe may be removed from a string after one inspection, experience has shown that periodic inspection is necessary to minimize drill pipe failures. The frequency of inspection depends on the drilling conditions as well as the condition of the pipe.

● **Magnetic particle inspection of pumps.** A certain rig caught fire and was partially destroyed. The insurance company's inspectors had all apparently usable parts of the rig salvaged and cleaned. A large mud pump was cleaned, sand blasted, and pronounced fit to return to service. The owner, however, had the pump inspected by the magnetic particle method, by one of the field trucks in the area, and three cracks, extending completely through the main castings, were found. Either of two of these cracks probably would have caused failure of the pump. The pump was immediately scrapped, and a very costly shut down of the rig was avoided.

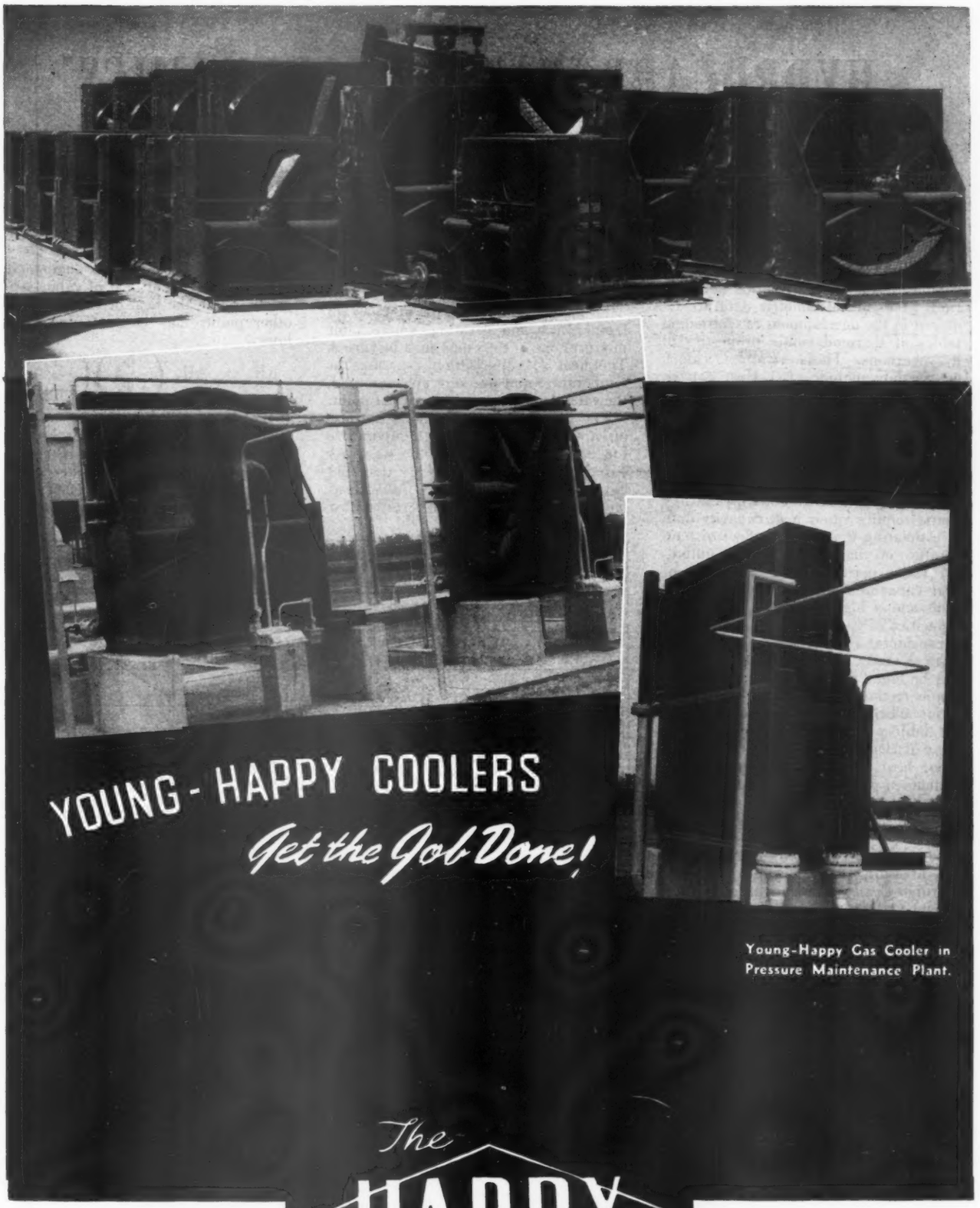
Engines as well as pumps are subject to fatigue failures, or the quite frequently erroneously called "crystallization" of metals. During the periodic overhaul of these machines, inspection by the magnetic particle method may disclose fatigue cracks that would finally result in failure. Fatigue cracks have been found in crankshafts, fillets, connecting rods, pistons, and gears. The inspection of engine and pump parts is probably one of the widest known applications of magnetic particle inspection today.

● **Inspection of sucker rods and tubing.** Records show that sucker rod failures are somewhat similar to those of drill pipe. Failure usually occurs near the box or pin end of the rod, and usually results from fatigue or corrosive fatigue. Periodic magnetic particle inspection, during the servicing of a pumping well, will eliminate many of the sucker rod failures.

Tubing inspection can be performed when the tubing is removed from the well for servicing. Several producers have established a policy of inspecting all tubing. Much tubing that would normally have been junked is salvaged, and the discarded tubing minimizes failures that would probably have occurred.

★ ★ ★

*Magnaflux, Reg. U. S. Patent Office, Trademark of Magnaflux Corporation applied to its equipment and materials non-destructive testing. Processes and methods in which such equipment and materials are used are covered by various U. S. Letters Patents.



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HYDROCARBON THERMODYNAMICS*

By **WAYNE C. EDMISTER,** Foster Wheeler Corporation

PART 2

● **Calorimetric data.** In addition to volumetric and phase relation data, various kinds of calorimetric data are required in the development of charts and tables of thermodynamic properties of hydrocarbons. These required calorimetric data include: (a) Heat capacities for liquids and vapors; (b) Joule-Thomson coefficients for vapors; (c) heats of vaporization, and (d) heats of formation and combustion.

By means of thermodynamics a minimum of calorimetric data go a long way.

The preparation of enthalpy-entropy charts require vapor heat capacity data in estimating the isobaric effect of temperature on the entropy and the enthalpy. The experimental determination of heat capacities requires precise equipment and a high degree of skill. Heat capacities of gases has been the subject of considerable experimental and mathematical study. Specific heats of gases may be found in two ways; (a) Spectroscopic method, and (b) with an adiabatic calorimeter. Without going into the subject further, it is sufficient for these discussions to present the plot of vapor heat capacities in Fig. 7. Heat contents of petroleum liquids and vapors have been determined, correlated, and published in the technical literature.

Joule-Thomson coefficients are determined by measuring the temperature and pressure changes while throttling the vapor slowly. As no quantitative fluid or heat measurements are involved, this determination is much easier than the measurement of specific heats. The isothermal pressure correction to the enthalpy can be measured by a similar procedure, in which heat is added during the expansion to maintain the outlet temperature the same as the inlet temperature. In this experiment the fluid flowing and the heat added must be measured. This amounts to combining the Joule-Thomson coefficients and the specific heat determinations in one experiment. As a matter of interest, the isothermal effect of pressure on the enthalpy may be computed from P-V-T data by thermodynamic equations.

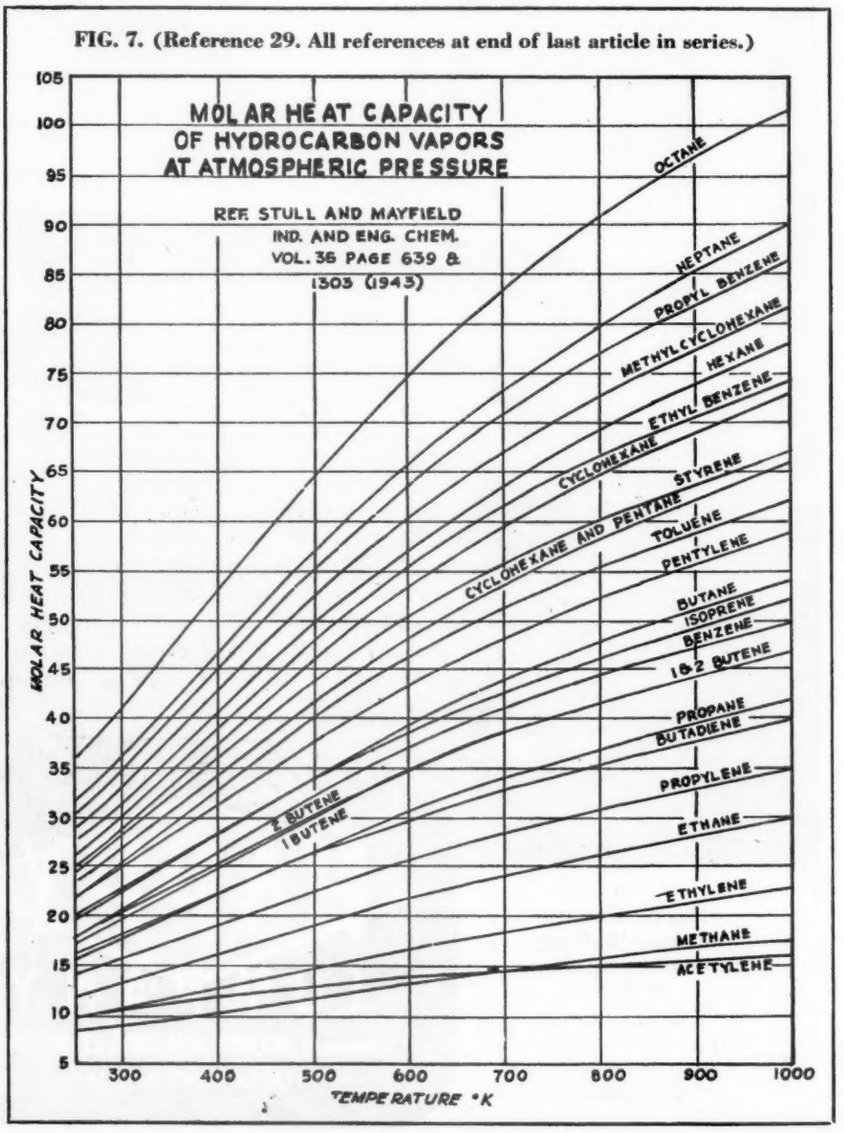
The latent heat of vaporization is required in preparation of enthalpy plots. This heat quantity may be determined experimentally or it may be computed from precise volumetric and vapor pressure data. Experimental data are desired, although the determination of latent heats of vaporization is not a simple matter. For pure components the calorimeter would operate at constant temperature and pressure, whereas for mixtures one or the other must be varied. The heat of vaporization decreases as temperature and pressure are increased, the value being zero at the critical point.

Fig. 8 is a plot of the molal entropy of vaporization vs. reduced temperature for hydrocarbons. This plot was prepared from experimental and calculated data. This plot may be used in estimating the latent heat of vaporization for mixtures as well as for pure components. Knowing the latent heat of vaporization at one point, the heat of vaporization at other points may be computed as follows:

$$\Delta H_2 = \Delta H_1 \left(\frac{\Phi_2}{\Phi_1}\right)\left(\frac{T_2}{T_1}\right)$$

Where values of Φ are the molal entropies, values of T are the absolute temperatures, and values of ΔH are isothermal latent heats or the difference between the saturated vapor and liquid lines at the same temperature. The value

FIG. 7. (Reference 29. All references at end of last article in series.)



*Presented before California Natural Gasoline Association, Los Angeles, November, 1945.

Thinking it through

[NO. 3 OF A SERIES]

The Proposition **In Fluid "Cat-Crackers," spent catalyst stripping is essential for optimum earning power.**

The Facts Spent catalyst, when withdrawn from the reactor, contains absorbed and entrained hydrocarbon vapors. Unless these vapors are recovered prior to regeneration of the catalyst, they are lost.

A modern stripping system removes these hydrocarbon vapors associated with the spent catalyst. This action has a twofold effect on the operation of the process. First, through recovering and returning the hydrocarbons to the product stream, it increases overall product output; and second, the recovery saves the additional regenerator capacity that would otherwise be required to burn the entrained and absorbed hydrocarbons.

These facts disclose immediately that the spent catalyst stripper results not only in an enhanced return from the charge stock, but also in both lower initial outlay and lower operating cost.

The Conclusion **There is no substitute for the best design**

THE M. W. KELLOGG COMPANY

Engineers and Economists to the Petroleum Refining Industry

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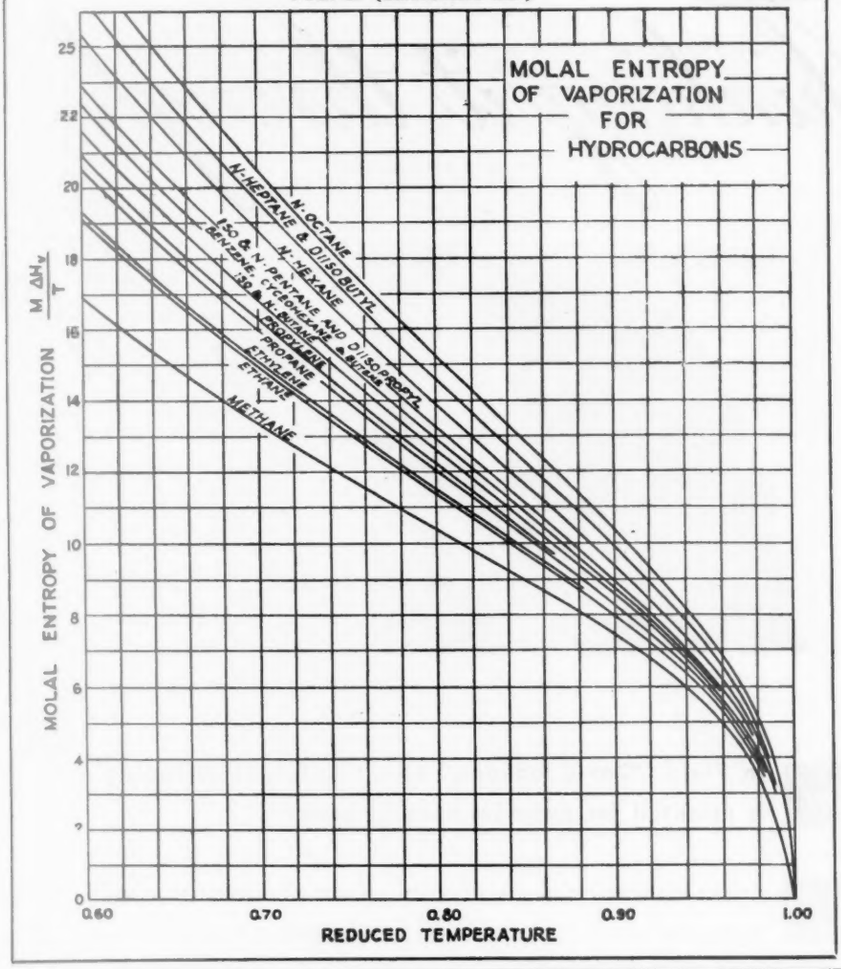
FIG. 8. (Reference 32.)



of the latent heat at the starting point, ΔH, should be at a sufficiently low temperature where pressure has little or no effect on the heat of vaporization.

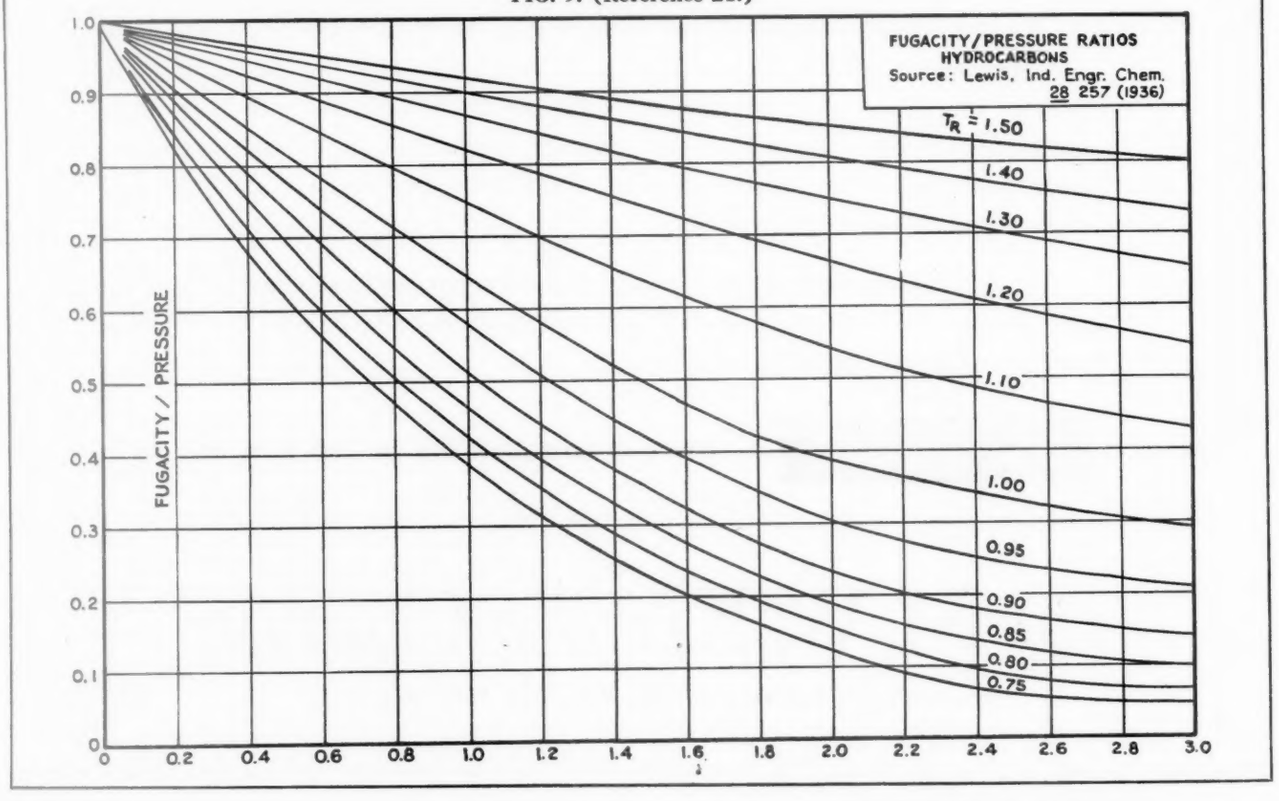
It is of interest to point out that the "isothermal" latent heat of vaporization. defined in this way, is not zero at the critical temperature, but is zero at the cricondentherm point or the point of maximum temperature on the border curve.

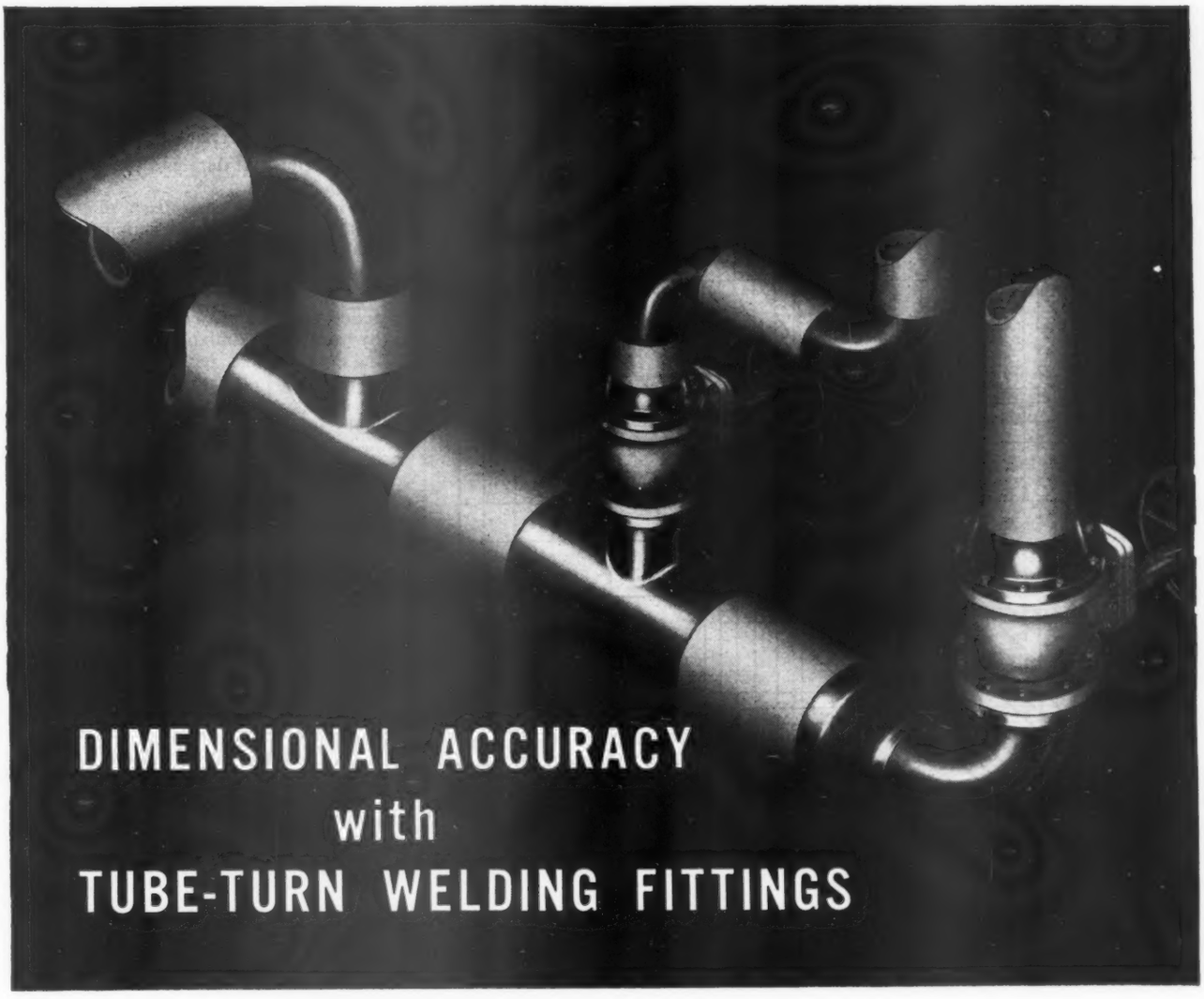
In computing the reduced temperature make the Φ readings from Fig. 8 and, applying the above equation, the cricondentherm or point of maximum temperature should be used instead of the critical or psuedo-critical so that the isothermal heat of vaporization for the mixture will be zero at the maximum temperature on the border curve.

Heats of combustion have two applications in hydrocarbon processing: (a) Combustion calculations, and (b) heats of formation and decomposition. The complete combustion to CO_2 and H_2O with an accurate measurement of the heat evolved, is readily accomplished in a constant volume bomb calorimeter. In most applications of calorimetric heat of combustion data, the process occurs at constant pressure rather than at constant volume, making it necessary to correct the calorimetric data to a "net" basis by allowing for the heat of condensation of the water formed in the combustion. Heats of combustion of hydrocarbon gases is readily determined at constant pressure.

● **Derived thermodynamic correlations.** The intermediate step between the thermodynamic equations and the experimental data on the one hand and

FIG. 9. (Reference 21.)





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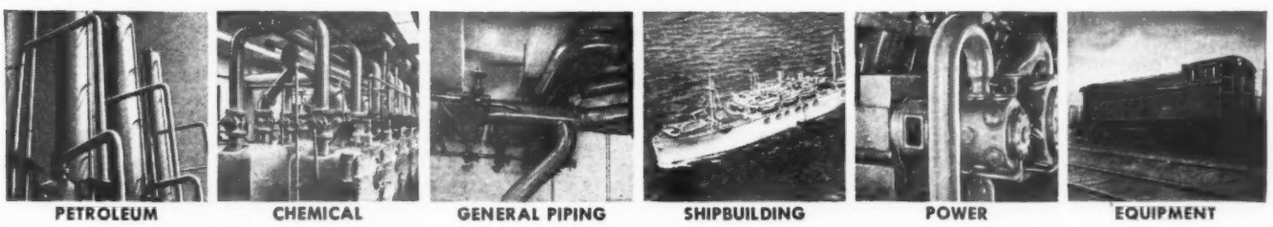
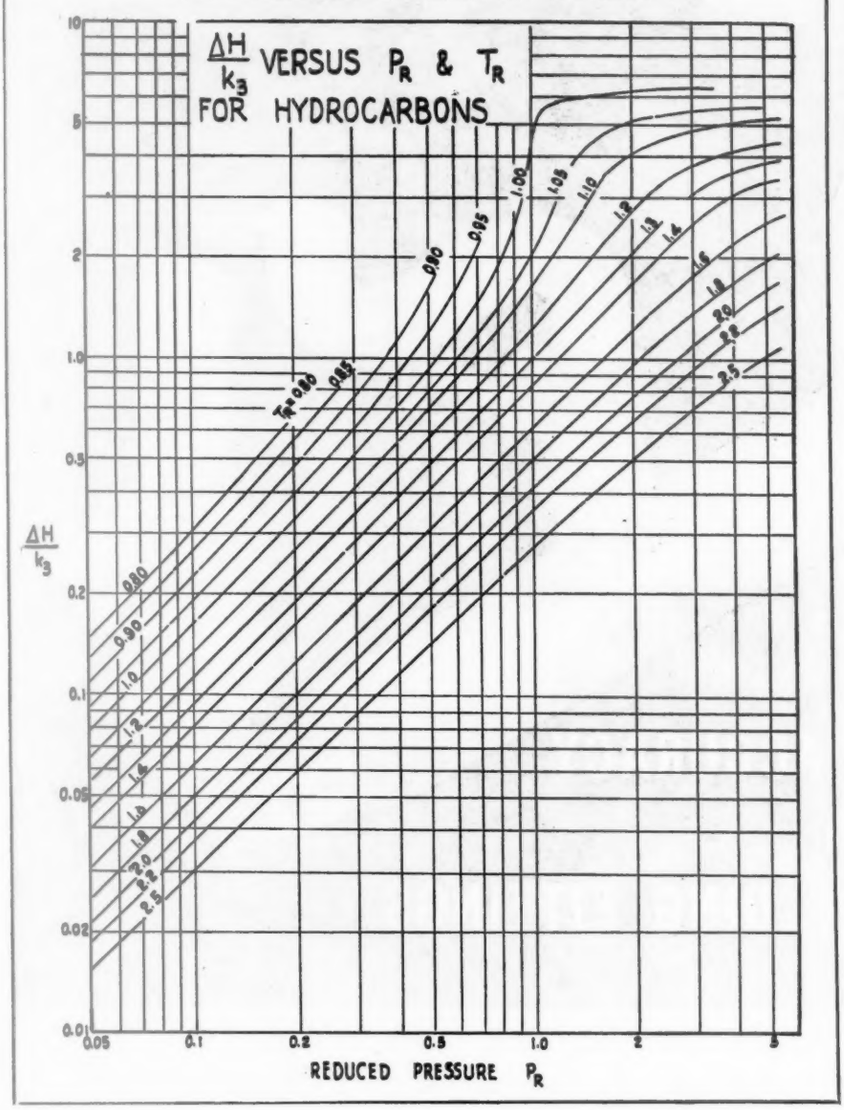


PETROLEUM | CHEMICAL | GENERAL PIPING | SHIPBUILDING | POWER | EQUIPMENT

FIG. 10. (References 6, 10, 18, 24, 26, 35, 36.)



the finished charts and tables of thermodynamic properties on the other hand is the development of derived thermodynamic correlations, such as those presented in Figs. 9, 10, 11 and 12. These correlations were prepared by graphical methods, using the equations given in Table 3 and the data correlations discussed above.

Fig. 9 is a plot of fugacity pressure ratio as a function of reduced temperature and pressure. This plot is for use in estimating fugacities of liquid and vapor hydrocarbons. The total pressure is used in calculating vapor fugacities and the vapor pressures are used in computing liquid fugacities, both readings being made at the same temperature, i.e. the temperature for which the equilibrium constants are desired. The critical conditions of the individual components are used in applying this chart. In using this chart to estimate phase equilibria constants for hydrocarbons, readings must be made for some components at conditions below their boiling point or where the components would be all liquid if not in a mixture with lighter components. In order to make the f/p plot applicable to these conditions the low temperature curves have been extended beyond the range obtained from P-V-T data. This has been done by means of experimental data. Therefore, Fig. 9 represents a composite of experimental data and thermodynamic calculations.

Fig. 10 is a generalized plot of the isothermal pressure correction to the enthalpy of vapors as a function of reduced temperature and pressure. The constant K_3 is in the same units as ΔH and is a function of the critical properties of the hydrocarbon or mixture in question, being equal to 0.1851 Pc $\propto_c$ B.t.u. per lb., where Pc is in lb. per sq. in. abs. and $\propto_c$ in cu. ft. per lb. Thus the ordinates and parameter of Fig. 10 are "reduced" properties depending upon the critical conditions. The critical residual volumes are not usually known for hydrocarbons or mixtures; however, K_3 can be correlated with Pc and Tc very readily. Fig. 10 was developed entirely from P-V-T data by the methods described above using the P-V-T correlation shown on Fig. 6. It is of interest to point out that this correlation was developed for pure hydrocarbons but has been used for mixtures as well as other gases, such as SO_2 with satisfactory results. In applying the correlation to hydrocarbon mixtures or petroleum fractions, pseudo-critical conditions must be used.

Fig. 11 is a similar generalized plot given an entropy function. In this case the constant K_2 is in the units as S^1 and equal to Pc $\propto_c$/Tc. With reference to the use of this plot, it should be noted that Fig. 11 gives part of the isothermal pressure correction to the entropy, the balance being obtained by integrating pressure as shown in the equation given in Table 3. By means of Figs. 10 and 11 and the critical properties, the isothermal effects of pressure on the entropy and enthalpy may be estimated for pure

TABLE 4—Phase equilibrium relationships for ideal and nonideal solutions. (References 2, 7.)

PHASE EQUILIBRIUM

Vapor Pressure Relationship

Combining Dalton's Law, $p = Py$ and Raoult's Law, $p = \pi x$ Gives

$p = \pi x = Py$ } Valid only at low pressures for ideal solutions

$K = \frac{Y}{X} = \frac{\pi}{P}$ }

K = Equil. Phase Distribution Const.

x, y = Mol Fract. in Liq. & Vap.

p, π, P = Partial, Vapor and Total Pressures

Fugacity – Escaping Tendency

For Perfect Gas

$\Delta F_T = RT \ln P_2/P_1$

For Actual Gas

$\Delta F_T = RT \ln f_2/f_1$

Where f is the Fugacity, which is defined to replace pressure, from which

$$RT \ln \frac{f}{P} = -\int_0^P \propto dP$$

where $\propto = V - \frac{RT}{P}$

Fugacity Equilibrium Relationships

Ideal Solutions – Fugacity of each component is proportional to its mol fraction at every temperature & pres.

$f_L X = f_V Y$

$$K = \frac{Y}{X} = \frac{f_L}{f_V} = \left(\frac{f_\pi/\pi}{f_p/P}\right)\frac{\pi}{P}$$

$f_L = f_\pi$ = Fugacity of pure component in liquid phase or at the vapor pressure, π.

$f_V = f_p$ = Fugacity of pure component in vapor phase or at the total pressure, P.

Non-Ideal Solutions — Fugacities of components in both liquid and vapor phases are functions of temp., pres., and phase compositions

1. Phase Diagram Method
2. Equil. Bomb Method
3. Convergence Pressure
4. Equation of State Method

FIG. 11. (Reference 6.)

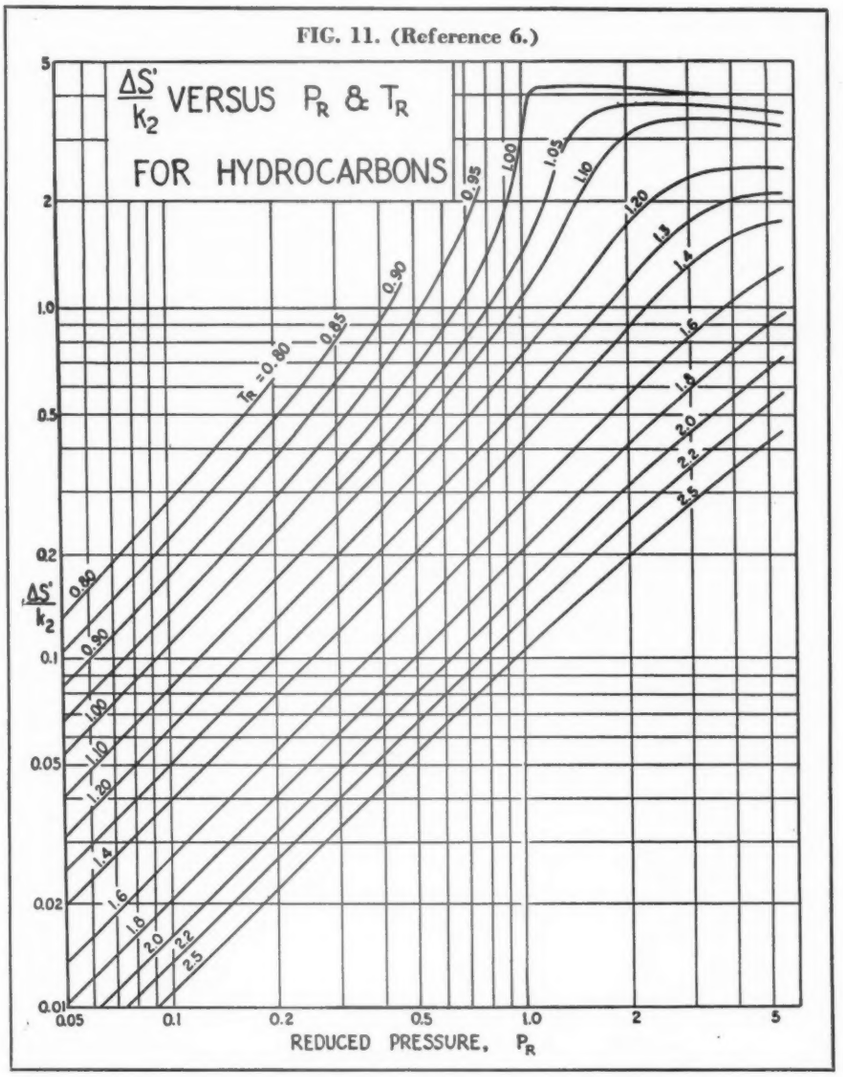
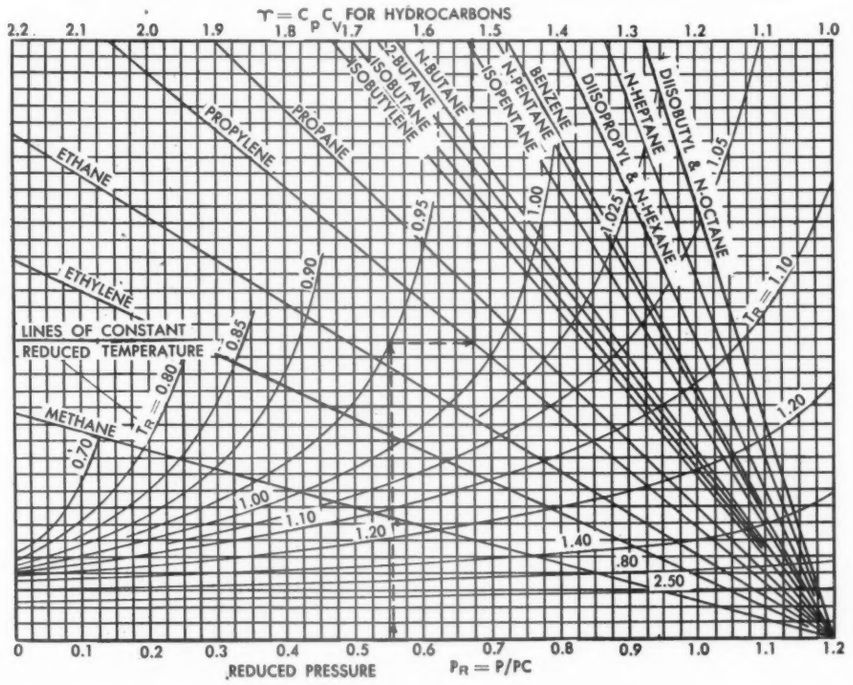


FIG. 12. Specific heat ratios for hydrocarbons. (References 6, 25, 37.)



hydrocarbons and their mixtures. A similar plot has been developed to give the isothermal pressure correction to the specific heat of vapors at constant pressure.

In Fig. 12 ratios of specific heats at constant pressure and constant volume are shown as a function of reduced temperature and pressure for various pure hydrocarbon vapors. This chart was developed from specific heats at a constant pressure of one atmosphere and the thermodynamic functions described above. This correlation shows the effects of temperature and pressure on the specific heat ratio. The Cp/Cv values may be determined for mixtures by assuming the values for individual components are additive or by using pseudo-critical conditions and average molecular weights.

There are two methods of making hydrocarbon gas compression calculations in use. One method is to compute the work and final temperature by means of the following well known equations:

$$HP = \frac{144\,P_1V_1}{33000}\left(\frac{\tau}{\tau-1}\right)\left[\left(\frac{P_2}{P_1}\right)^{\frac{\tau-1}{\tau}} - 1\right]$$

$$T_2 = T_1\left(\frac{P_2}{P_1}\right)^{\frac{\tau-1}{\tau}}$$

The other method is to use entropies and enthalpies, following a line of constant entropy to get the final temperature, and then finding the work equivalent of the difference in enthalpies at the initial and final temperatures.

The above compression equations are based on the perfect gas law and are not strictly valid for actual gases such as hydrocarbons. These equations have been used on air for years with good results but air is much closer to a perfect gas than are hydrocarbon vapors. Another well known application of the above equations is for the compression of ammonia in refrigeration cycles. Here, also, satisfactory results are obtained as judged by good agreement with Mollier diagram results. The explanation for this good agreement lies in the value of the exponent used. It appears that the value of τ used in the above equations was selected to give good agreement with Mollier the diagram results. The same could be done for any gas, steam, SO_2 or hydrocarbons. Such values of τ would be pseudo specific heat ratios and not actual Cp/Cv values. It should be emphasized that the values of Cp/Cv given in Fig. 12 are not pseudo values designed to be used with the above equations to give results comparable with Mollier diagram calculations. It would be desirable to develop such a correlation or, as an alternate, modify the above compression equations to be valid for actual gases.

The above inconsistency between Fig. 12 and the perfect gas law compression equations is an answer to criticisms of this Cp/Cv correlation. Another point to be mentioned in this connection is that the temperature of the gas leaving

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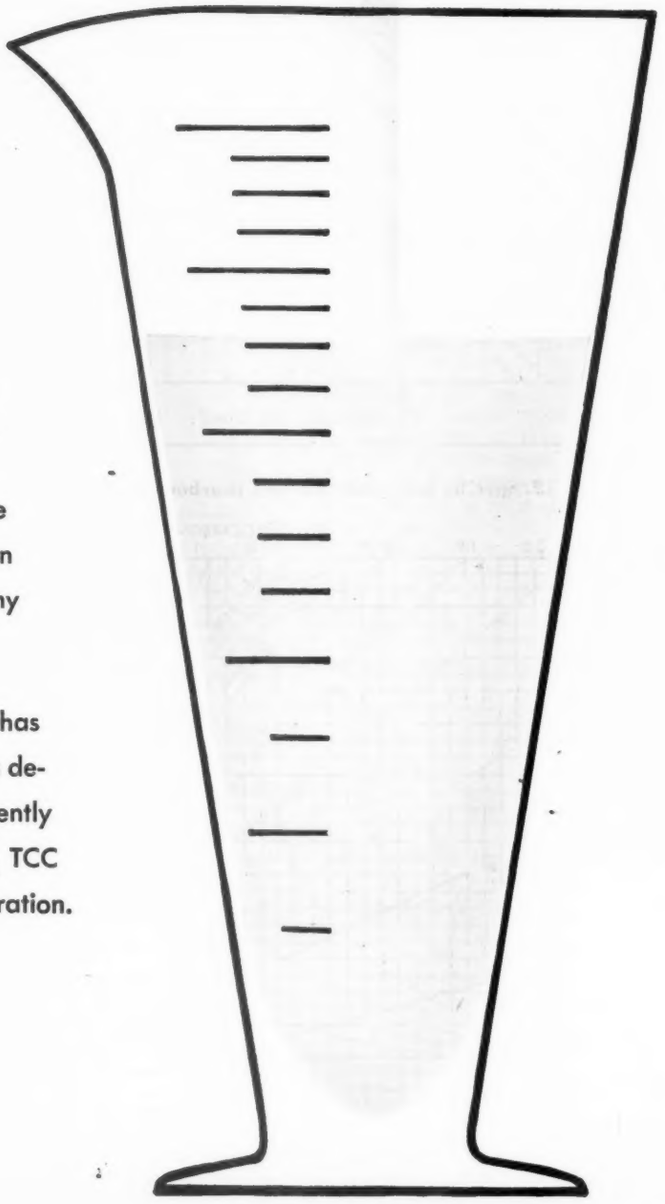

• *Thermofor Catalytic Cracking* will do it. Not only will TCC assure greater yield of the petroleum refinery's main profit item, but it will be *high octane* gasoline—which current statistics show is in steadily increasing commercial demand.

• TCC also means less destruction of valuable light products in meeting today's required octane levels.

• With a Badger-designed TCC unit, high octane gasoline can be produced more economically than the low-grade finished stocks coming from many older types of equipment.

• Badger has pioneered in catalytic cracking . . . has led in many of its processing improvements . . . has designed and built plant after plant . . . is preeminently fitted by experience and facilities to build *your* TCC unit quickly and put it into efficient initial operation.

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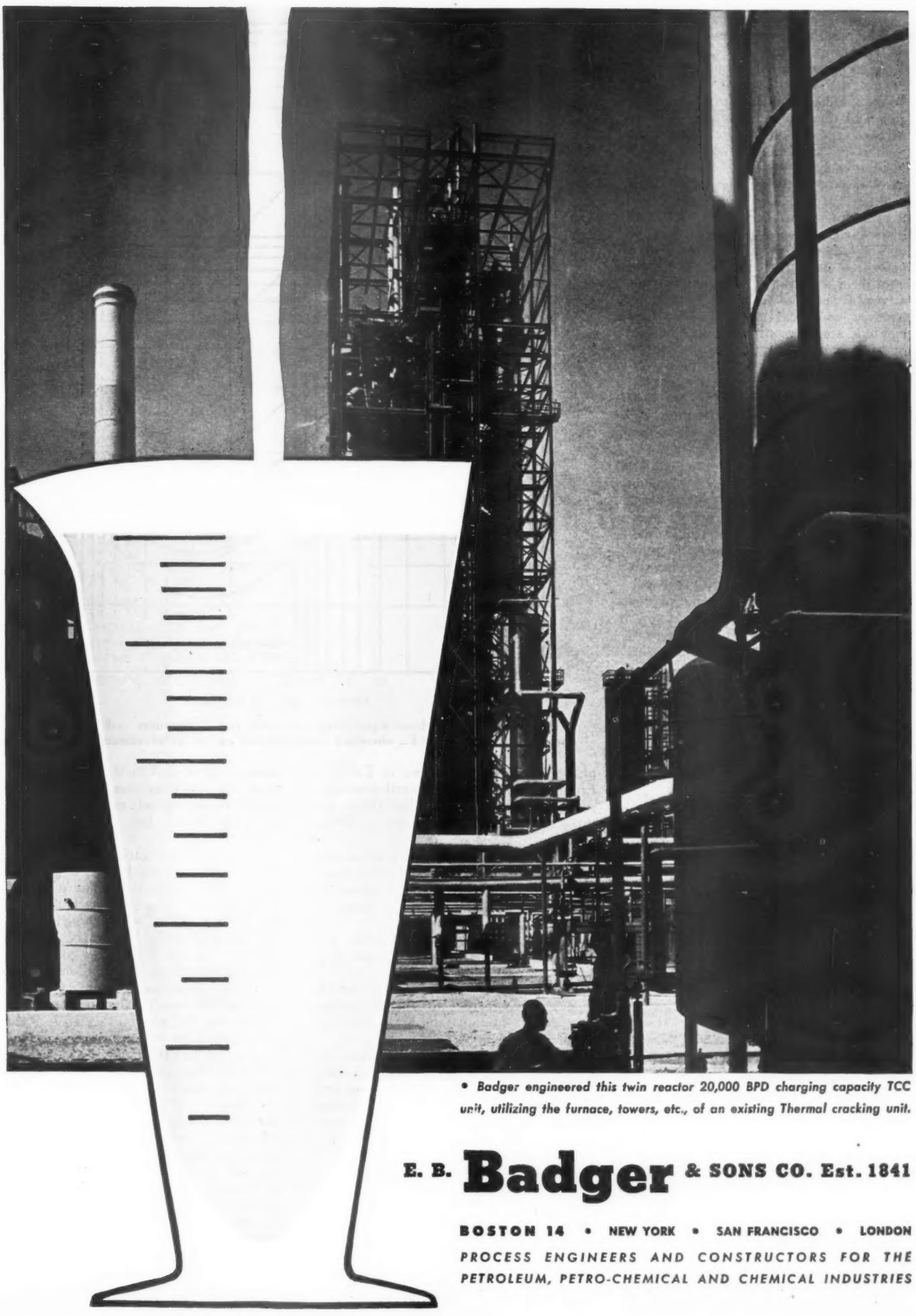

• *Badger engineered this twin reactor 20,000 BPD charging capacity TCC unit, utilizing the furnace, towers, etc., of an existing Thermal cracking unit.*

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PROCESS ENGINEERS AND CONSTRUCTORS FOR THE PETROLEUM, PETRO-CHEMICAL AND CHEMICAL INDUSTRIES

a compressor is not always the same as the temperature leaving the cylinder due to the design of the valves and the gas passages around the cylinder. For this reason, the work of compression should be computed for an isentropic compression and the exit temperature obtained by correcting the isentropic temperature for the design of the gas coolers following the compressor.

● **Phase equilibria.** The equilibrium relationship between vapor and liquid is of major importance in practically all hydrocarbon processing operations. As outlined above in the discussion of vapor pressures and phase diagrams, phase equilibria conditions for hydrocarbon mixtures may be estimated by component or empirical methods. Empirical methods are used only on higher boiling hydrocarbon mixtures, such as petroleum fractions, that are normally defined by laboratory distillation curves. The component method is always used for lighter hydrocarbon mixtures and may be used also for the higher boiling hydrocarbons, particularly in the gasoline and naphtha range.

Such fractions are usually broken down into "hypothetical" components from distillation curves to permit making the component phase equilibria calculations. In the gasoline range the presence of lighter hydrocarbons usually makes it impractical to apply the empirical method so the component method is used.

The fundamentals of component phase equilibria are shown in Table 4. From this concise presentation of the subject it can be seen that there are three different types of phase equilibria relationships:

(1) The vapor pressure relationship where vapor pressures and total pressures are used, which can be done at low pressures, and/or high temperatures;

(2) The ideal solution fugacity relationship, where fugacities from Fig. 9 may be used, and

(3) Non-ideal solutions, for which fugacities corrected for the deviations from ideal solutions must be used for either or both phases.

Most phase equilibria conditions encountered in hydrocarbon processing fall under the second classification and for these calculations the equilibrium constants computed from Fig. 9 are adequate. In this connection it is of interest to refer to Fig. 1, which shows a comparison of fugacities of liquid and vapor with the vapor pressures and total pressures. From this nomograph, one can see at a glance where fugacities differ appreciably from vapor pressures and total pressure. This chart is presented for reference only and is not intended for use in making calculations. From Fig. 1 it can be seen that the vapor fugacities of methane are not far from the total pressure, whereas the liquid fugacities of methane are appreciably lower than the vapor pressures.

In computing fugacity phase equilibrium constants from Fig. 9, it is necessary to extrapolate the vapor pressures of the lower boiling hydrocarbons above their critical point. This is done on semi-log paper plotting log of the reduced pressure against reciprocal of the reduced temperature. Calculations of this type have been made by many in the past and the results plotted to give the well-known "K" charts. Fig. 13 is a plot of this type for several light hydrocarbons at 300° F. It will be noted that the curves all converge at a value of K=1.0 and a pressure of 900 lb. per sq. in. abs.

At the critical point of a mixture there can be no separation into vapor and liquid phases, the mixture being of a homogenous continuous phase between liquid and vapor. At this point the equilibrium constants for all the components present must be equal to unity to satisfy this condition. Under other conditions of temperatures and pressure, the "K" constant curves approach unity also, but at a higher value of pressure. The pressure at which the K constants become unity is called the "convergence pressure." This

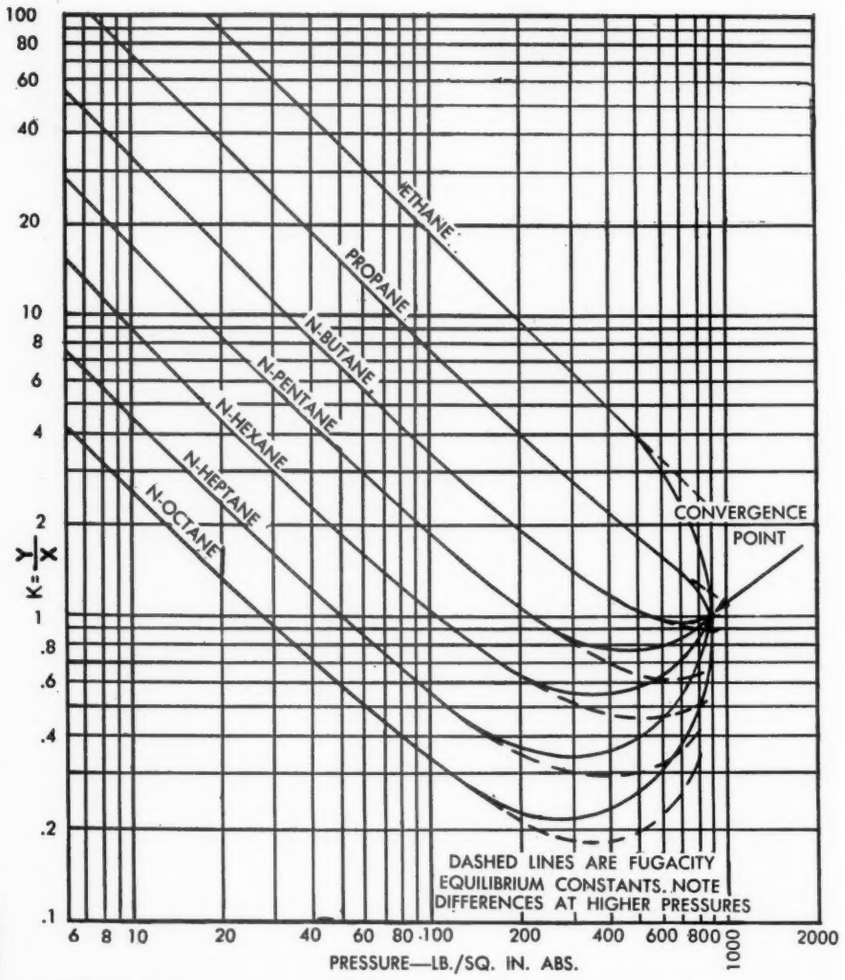

FIG. 13. Fugacity phase equilibria constants for components of hydrocarbon mixture at 300°F., showing convergence point. (References 14, 34.)

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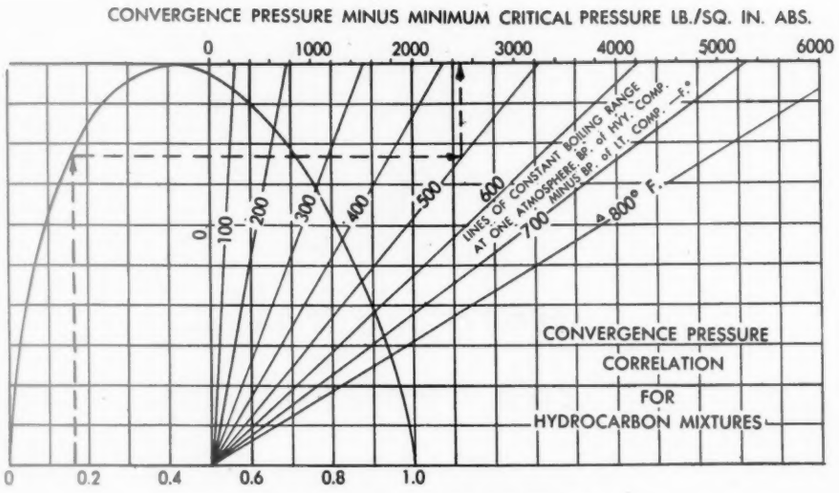


FIG. 14. (References 16, 19, 27, 28, 30, 34.)

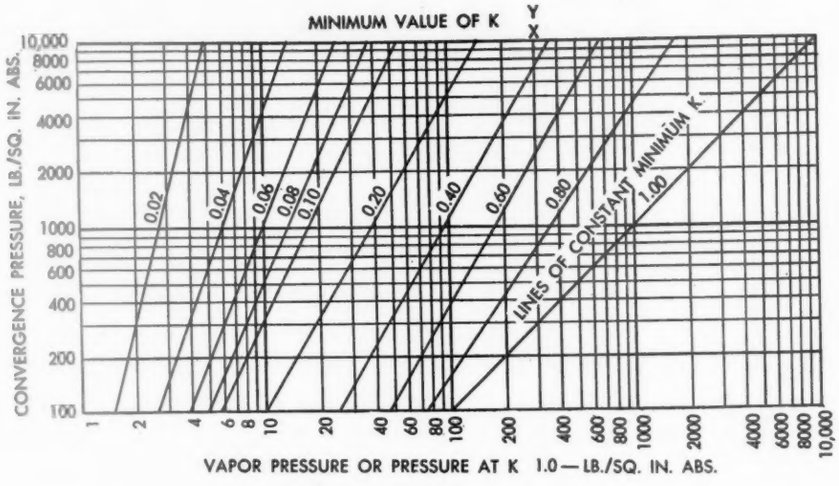


FIG. 15. (Reference 34.)

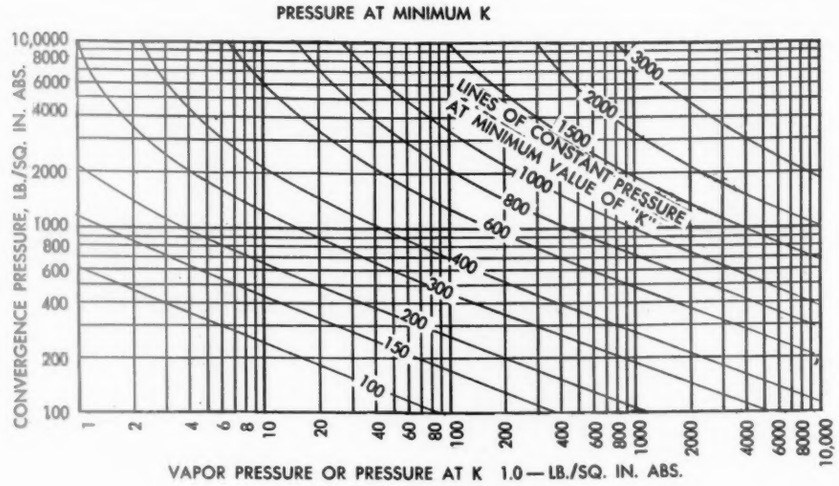


FIG. 16. (Reference 34.)

intersection at unity may be real or imaginary, real when the system temperature is the critical temperature of the mixture, and imaginary otherwise.

The "K" curves become discontinuous at the border curve when extrapolated toward a fictitious convergence pressure at temperatures below the critical temperature of the system.

It will be noted on Fig. 13 that the fugacity K constant curves show that this tendency to converge exists for ideal solutions (see dashed lines). For non-ideal solutions, this trend toward convergence on K constant curves takes place at lower pressures. This is one characteristic of non-ideal solutions.

When the temperature of the system is the same as the critical temperature of the mixture, the convergence pressure is the critical pressure of the mixture and the K constant lines converge to unity on this plot. When the temperature of the system is below the critical temperature of the system, the convergence pressure is an imaginary pressure, at which the K constant curves would converge if extrapolated, and is used as a tool to correct for deviations from ideal solutions. With a method for predicting the convergence pressure, the minimum value of "K" for each component and the pressure at the minimum K, values of K may be corrected for deviation from ideal solutions at high pressures by plotting as on Fig. 13.

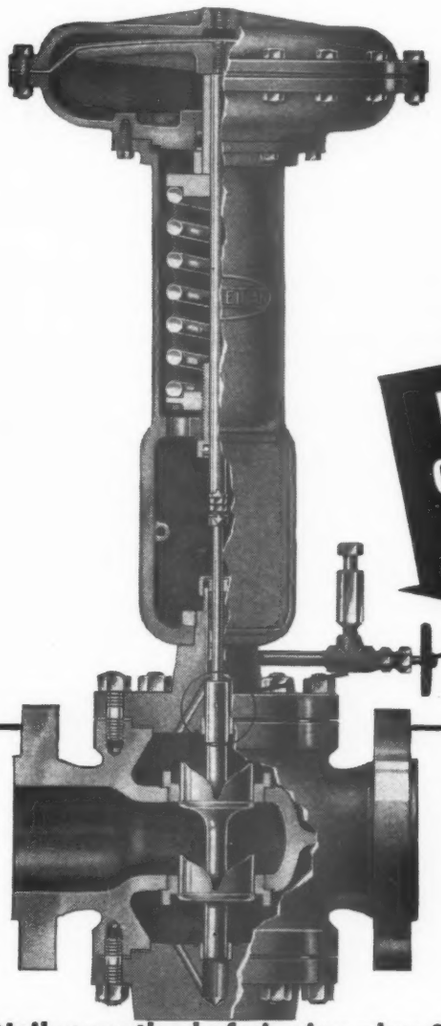
The prediction of the convergence pressure is the most difficult part of this problem. Experimental phase equilibria data available indicates that the convergence pressure may be estimated as the critical pressure of an imaginary mixture of the lightest and heaviest components, the proportions being such that the binary has a critical temperature equal to the temperature of the system. From critical data appearing in the literature for binary mixtures, a plot has been constructed to give the approximate value of the convergence pressure or the critical pressure of binary mixtures. This chart is given as Fig. 14, which is presented for reference only, this correlation not being accurate enough for very precise calculations. Approximate as this plot is, it indicates the effect of the variables on the convergence pressure. In a similar manner Figs. 15 and 16 were prepared from information available in the literature by reconstructed correlations given in the indicated reference. These correlations give the minimum value of K and the pressure at this minimum value as a function of the convergence pressure for the mixture and the vapor pressure of the component in question. By means of the correlation presented in Figs. 14, 15, and 16, it is possible to estimate values of K where laws of ideal solution do not apply. The use of these 3 charts (Figs. 14, 15, and 16) to construct a plot similar to Fig. 13 requires no explanation.

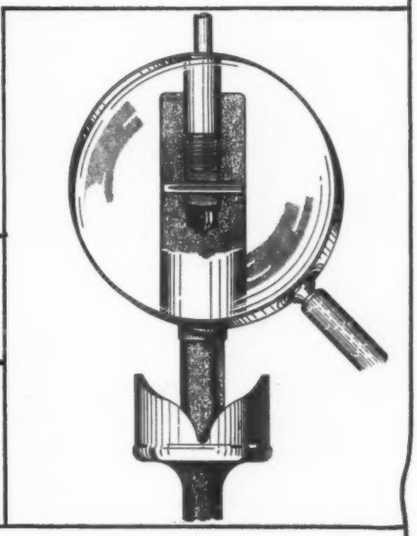
Another method of estimating phase equilibria constants in the non-ideal solution range is the computation of the fugacities of both liquid and vapor phases by means of a precise equation of state that applies to the mixture in question. These liquid and vapor fugacity equations are functions of the compositions of the phase in question, as well as the temperature and pressure and therefore very complex equations to formulate. In addition the results are difficult to apply because many successive aproximations are required in order to determine the phase composition, which is required in estimating the fugacity.

(The third and last installment will appear in an early issue.)

ATTENTION TO DETAIL

Pays Off in Control Valve Performance



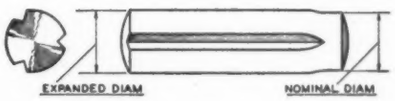


Note: One skirt of the valve plug is 90° out of position in relation to the other.

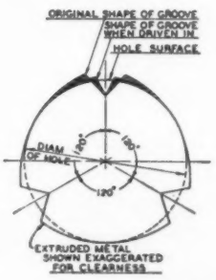
Mason-Neilan method of pinning plug & plug stem assures strongest possible assembly

The tee head construction used on some earlier control valves required clearance between the stem and plug to allow for bonnet and seat misalignment, permitting lost motion (vertical and rotary) which cannot be tolerated since the plug must respond to the slightest pressure change on the diaphragm.

The present Mason-Neilan threaded and pinned stem and plug construction does away with all toggles and free alignment joints, yet any tendency towards binding has been eliminated by pilot machining on the bonnet and blindhead and by holding all machine operations to close tolerances. The plug guide is drilled and tapped with a pilot section above the threads for accurate centering of the stem. The threaded joint provides the mechanical strength for holding the two parts together. The stem is locked into the plug by a special grooved pin which fits tightly at both ends in the guide as well as in the center through the stem.



Pins have three grooves extending from end to end, except for a short distance on one end which is the nominal diameter of the pin and serves as a pilot for driving.



In forming the grooves, a portion of the metal is displaced locally at the sides leaving a bulge of extruded metal along the edges of grooves and resulting in an expanded diameter. The action consists of forcing the elastic bulges partly back into the grooves when the pin is hammered or pressed into the drilled hole, thus forming an extremely tight fit against the hole wall.

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EXPERIMENTAL WELL ON ATLANTIC COAST

Petroleum Engineer Picture Story

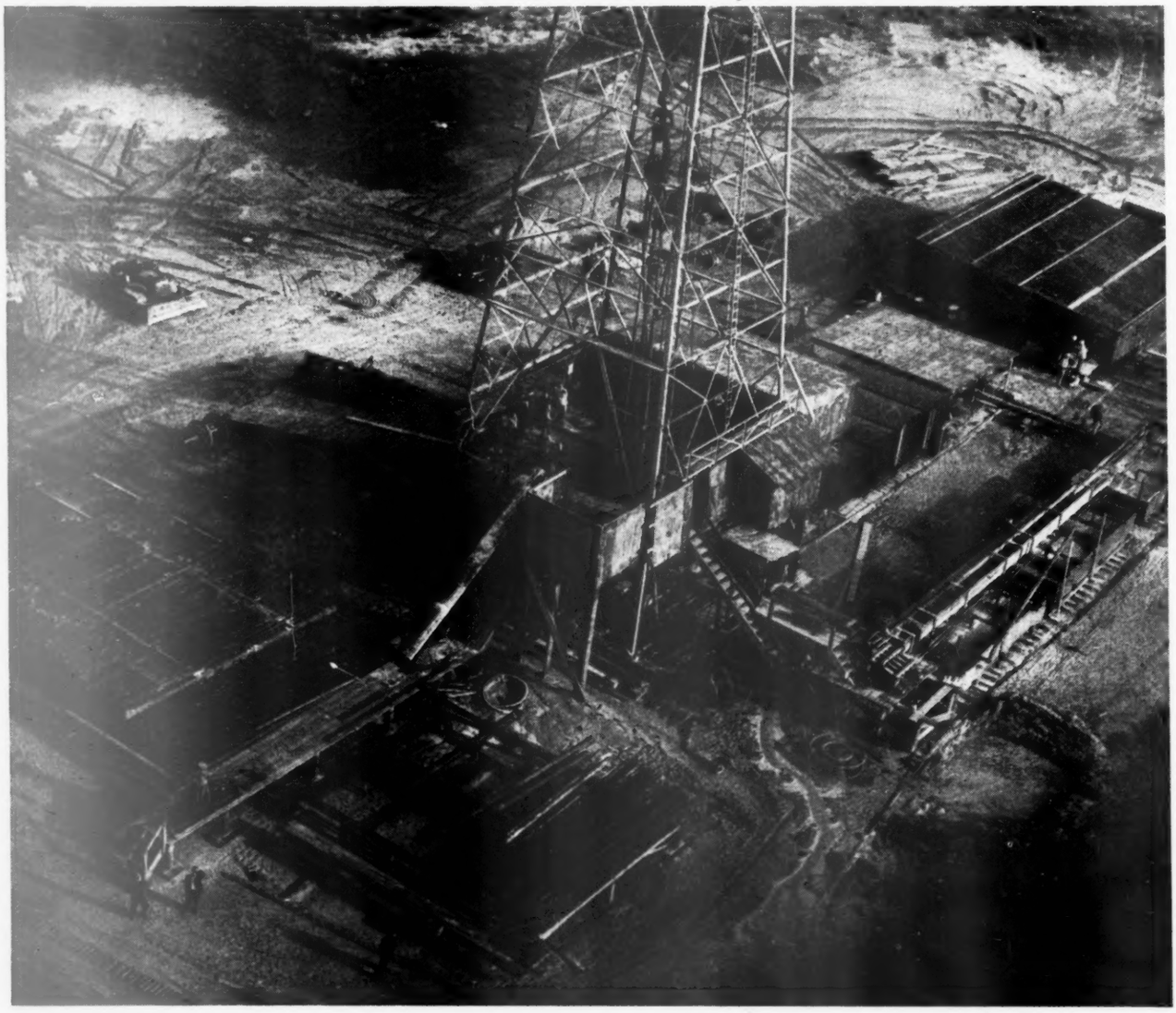
DIDN'T a governor of North Carolina say he'd drink all the oil found in his state? If he is still around he must be eyeing anxiously the progress of the Standard Oil Company of New Jersey No. 1 Hatteras Light unit. With the Atlantic Ocean on one side and Pamlico Sound on the other, a 168-ft. rig stands on the stormy outer coastline that is formed by a string of thin islands. Nearby is the historic Cape Hatteras lighthouse that watches over "the graveyard of the Atlantic."

Great care was taken in the preparations and now in the actual drilling operations because information is to be sought more assiduously than oil itself. Standard has acquired a large block of leases in the vicinity of Buxton, North Carolina, and this first test will point the direction of future exploration. The well is now below 6500 ft. It found some water in the Tuscaloosa formation but may pick up a sand before reaching the granite.

Drilling of the test followed more than two years' study of the Atlantic Coastal Plain region by company geologists.

Appearance of the steel spiderweb on the East Coast may foreshadow tremendous new discoveries. Drilling is expected to go to 8500 ft., a fairly shallow test in these days.

Air view of Standard Oil Company's Atlantic Coast well where drilling is below the first mile. In checking samples from the well the North Carolina geological survey staff discovered minute geological specimens declared not previously found in any other test hole in this country. The well is experimental with information the main purpose.



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MODEL E — a twin-engine, double drum draw works for drilling to 6,000 feet with 4½" drill pipe and workover jobs to 12,000 feet.

MODEL S — a single-engine, single drum draw works for drilling to 4,500 feet with 4½" drill pipe, or workover jobs to 10,000 feet.

CARAVAN RIG — a 90-foot telescoping pipe derrick for drilling operations to 5,500 feet, or workover jobs to 10,000 feet. Derrick telescopes to one-half its length and is carried on semi-trailer with utility section. Special engine operates hydraulic rams and winch for raising and extending derrick, and drives the rotary table, light plant, wash-down pump, air compressor, electric welder, and hydraulically erected and telescoping dog house. This makes a complete drilling outfit with which any draw works can be used.

MODELS H, K and R — Combination rotary or cable tool (spudder or beam) double drum drilling rig. Rotary drilling to 5,000 feet with 4½" drill pipe, cable tools to 7,500 feet and servicing to 10,000 feet.

MOBILHOIST — a self-propelled, rubber tired, combination rotary or cable tool drilling or servicing rig for drilling to 1,500 feet with rotary, 3,500 feet with cable tools or 4,000-foot servicing jobs.

MODELS Q, H, K and S — four sizes of single drum servicing hoists for wells 2,000 to 12,000 feet.

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Even a rig with the same motor, steel and other materials would not compare with a "Cardwell" in length of life and low maintenance costs. Our twenty years of "know how" in design, fabrication and heat-treating cannot be compared because all these are the result of actual field experience. During this time we have made careful studies of worn parts on old rigs and have changed design, materials or heat-treatment to prolong their wearing life. These improved parts are standard for current machines and always used as replacements on rigs in the field. Our methods of parts improvement is bringing us nearer our goal of building rigs that will not wear out. This policy is the greatest dollar value in "Cardwell" rigs and makes them a "measuring stick" that cannot be duplicated.

When you purchase a "Cardwell" rig, you get something more than iron and steel parts bolted or welded together — you get a rig that is built around one objective — "THE BEST POSSIBLE RIG AT THE LOWEST POSSIBLE PRICE." Only when we reach our goal of building rigs that will not wear out, will we feel our objective has been reached.

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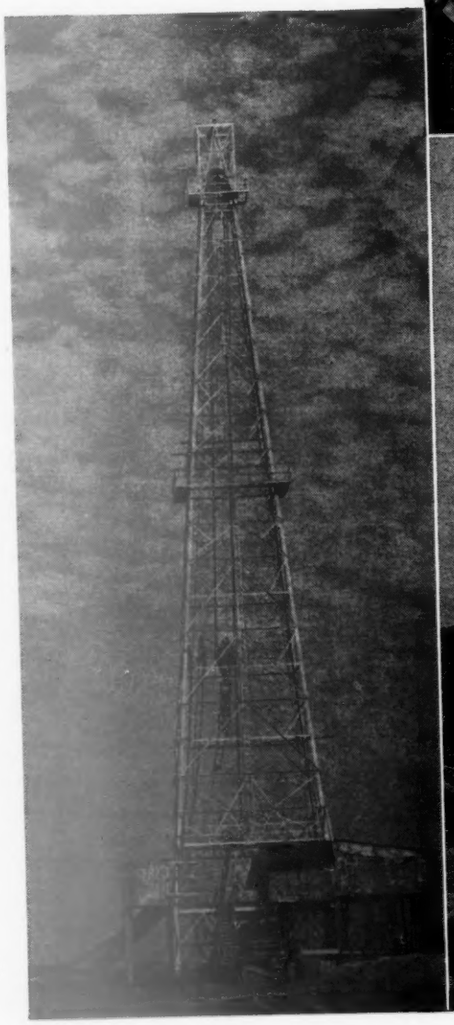
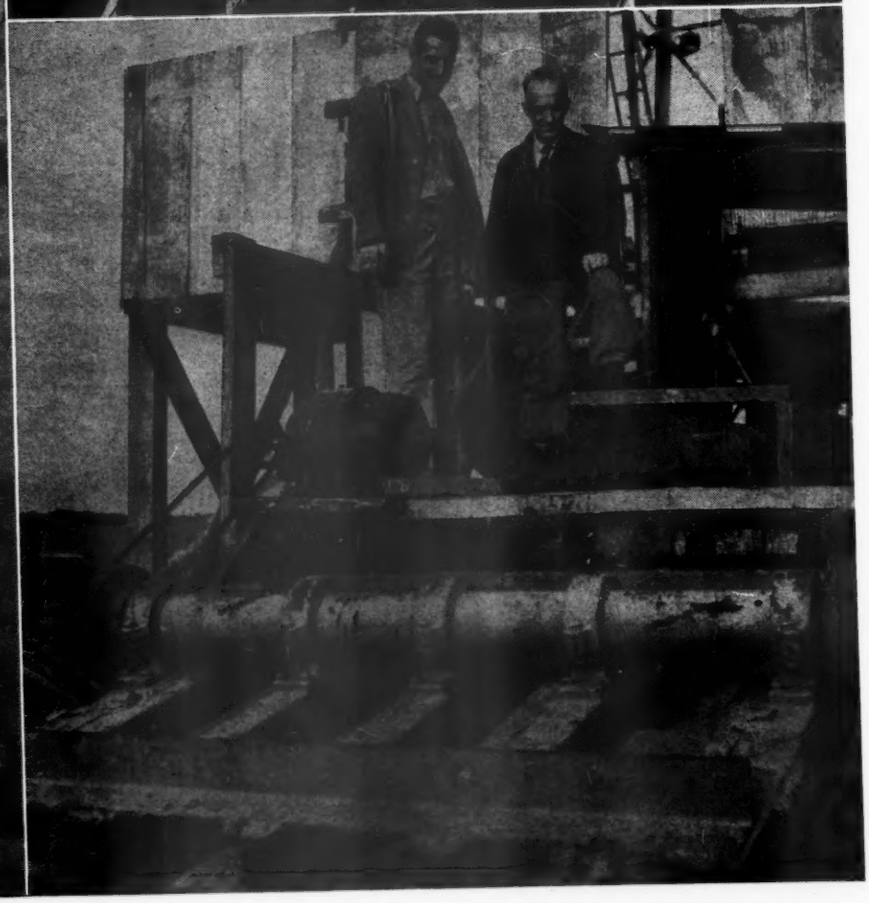
Right, looking upward through the 168-ft. rig with one of the crew in foreground. The derrick itself is 136 ft. by 30 ft. The Cape Hatteras lighthouse reaches 197 ft. above the sandy coast and stands east of the test well.

Below, general view of derrick looking northeast to the ocean. Equipment in operation includes two 325-hp. diesel engines compounded to drive an 18-in. pump and two 125-kw. generators. A 100-hp. diesel supplies power for a standby pump.

Ed Leroux, Carter petroleum engineer, and Standard Oil's K. D. White inspect the shale shaker, lower right. Machine is used to remove particles from drilling fluid for technical data. Information of the area is the primary objective of the test.

STANDARD OIL (N. J.) PHOTOS.





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Mission swabs are rugged in construction and give long, efficient, trouble-free service.

On your next swabbing job, specify Mission Valveless Swabs.

DOWN TRIP

Note how the split rubber principle gives large fluid passage area. A Mission swab will fall fast, even through viscous or gas-laden fluid.

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The split rubbers close to effect a tight seal. Even if blocked open one-half inch, there is ample sealing area to lift a heavy load. Rugged, valveless construction assures long life and trouble-free service.

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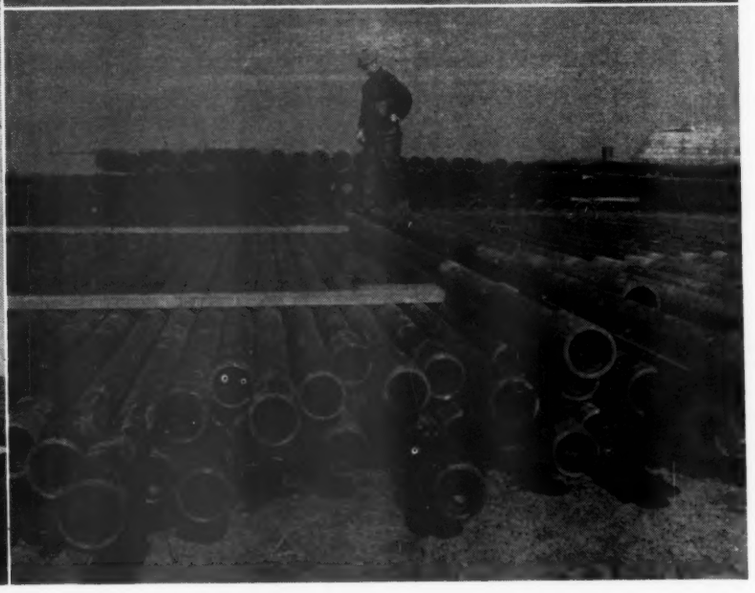
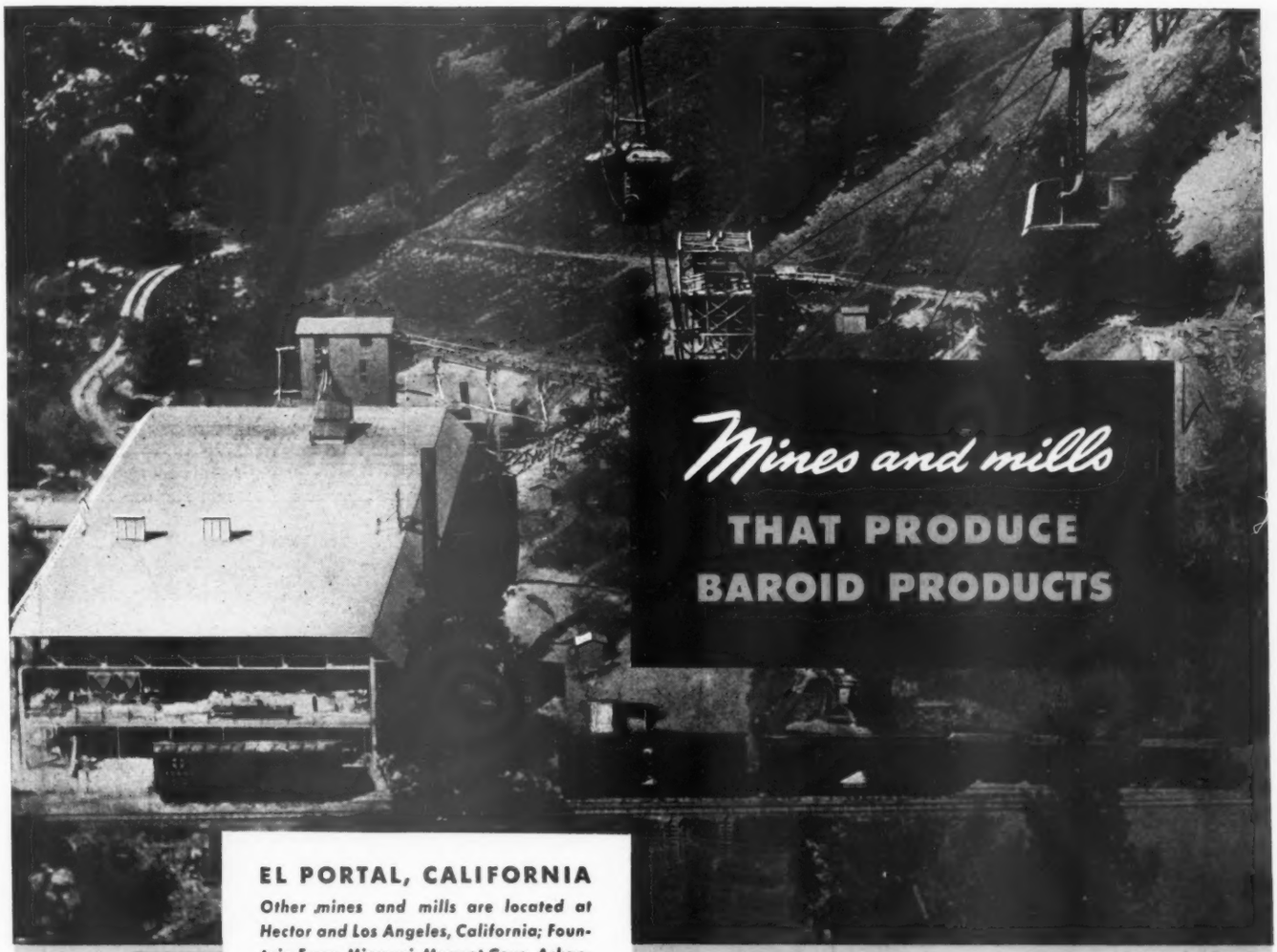
In the two scenes above, the drilling crew is locking the "kelly." The key being dropped in place transmits power from turntable to kelly.

Right, supplies are hauled over the sandy marshes from the new harbor at Buxton, North Carolina. Here is one of the big caterpillar tractors that are used for the purpose.

Below, a truck unloading cement at the Hatteras Light well No. 1. Right, drill pipe stacked at Buxton ready for the haul to the Cape.

THE END.





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GAS-DIESEL ENGINE DEVELOPMENT

By **RALPH BOYER**

Chief Engineer, Cooper-Bessemer Corporation

EXCLUSIVE

INTRODUCTION of the gas-diesel engine, able to burn gas fuel with diesel-cycle efficiency and to operate on combinations of oil and gas fuel, naturally evoked widespread interest and much discussion regarding the history of this development. Tracing general history is not here the purpose of the writer, but rather to report progress of the line of development with which he is most familiar, a line that includes application of the gas-diesel principle to 2-cycle as well as to 4-cycle and to both atmospheric and supercharged engines.

The first gas-diesel engine, to the writer's knowledge, was designed in 1927 and operated successfully at Cooper-Bessemer in 1928. It was a 12-in. by 16-in. 300-r.p.m. 2-cycle engine, the piston underside and crosshead topside pumping scavenging air. Fig. 1 shows a cross-section of this experimental unit.

The original Cooper-Bessemer engine, as well as subsequent developments, centered around high-pressure gas injection. It had not occurred to us that fuel gas could be admitted with intake air and the mixture compressed to high levels. In fact, we knew at that time it couldn't be done, because compression pressures of more than about 125 lb. per sq. in. could not be used on any of our standard gas engines. We now know that gas-air mixtures can be compressed to full diesel pressure levels without pre-ignition. What makes this possible?

Actually there is no mystery; it is simply a matter of gas-air ratio. In contrast to the otto cycle of the standard gas engines, the diesel cycle operates with a considerable amount of excess air; so even at full load the mixture is quite lean. At partial loads it is even leaner because the diesel admits a full charge of air at all times. Thus the ratio is such that the mixture will not fire at all until considerable flame energy is applied as pilot-oil combustion.

Gas-diesel development at Cooper-Bessemer has followed three lines, each with its own problems and charaeteristics: (1) 4-cycle atmospheric, (2) 4-cycle supercharged, and (3) 2-cycle.

By this time, most engineers know of pioneer developments in England using low-pressure gas and are familiar with the fact that these engines employed intake valves, which not only opened the air passage but also admitted gas. Using this gas-admission arrangement means that the gas-diesel cylinder head is entirely different from that of a standard diesel. Because the gas-diesel development appeared to offer attractive possibilities for conversion of existing oil engines we centered our program around simplicity, not only for more economical application to engines in production but also to make possible application of the gas-diesel principle to diesels already in the field.

Experiments on various forms of gas admission led to the simple arrangement of Fig. 2. Theoretically this is not ideal, for the gas flows into the intake passage continuously while the valve is closed. Actually, however, gas and air mix completely and there is no evidence of stratification. This form is now standard on all Cooper-Bessemer models, available in several sizes. Fig. 3 shows a JS engine, rated 770 hp. at 450 r.p.m., and Fig. 4 shows fuel-consumption per-

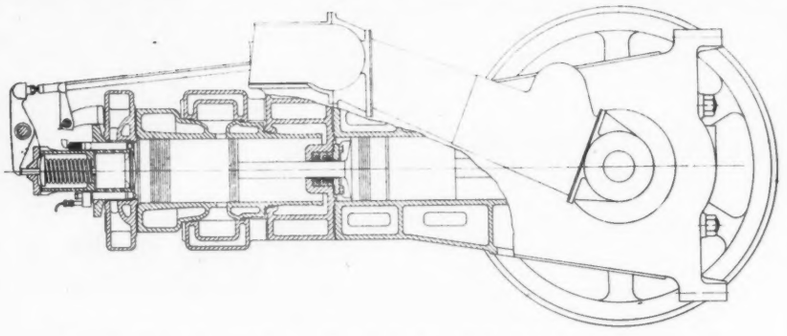


FIG. 1. Experimental gas-diesel designed in 1927 and operated in 1928. Piston underside and crosshead topside pumped scavenging air.

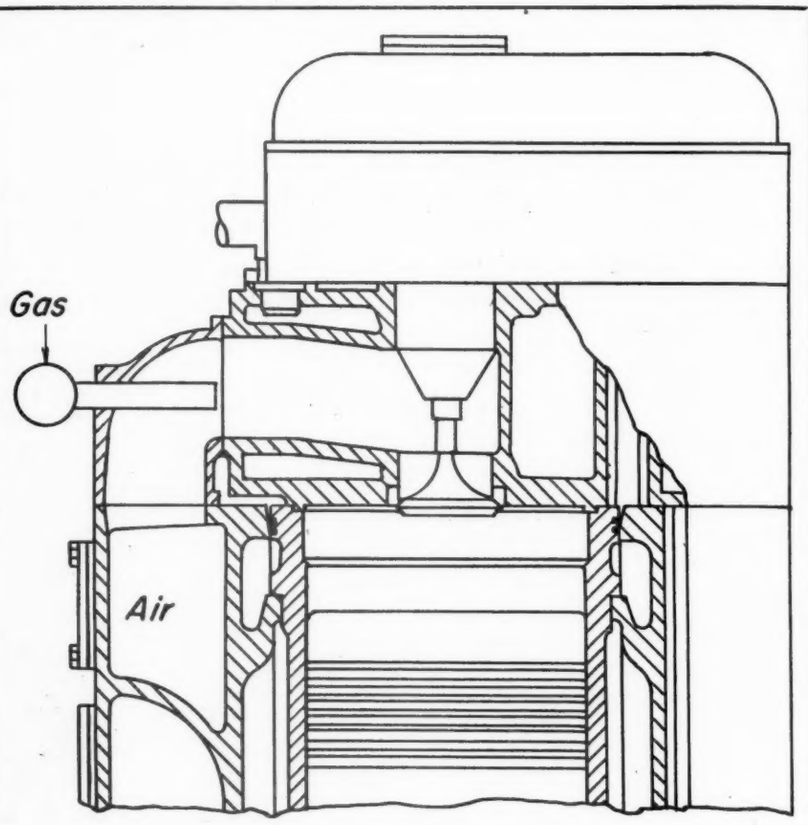
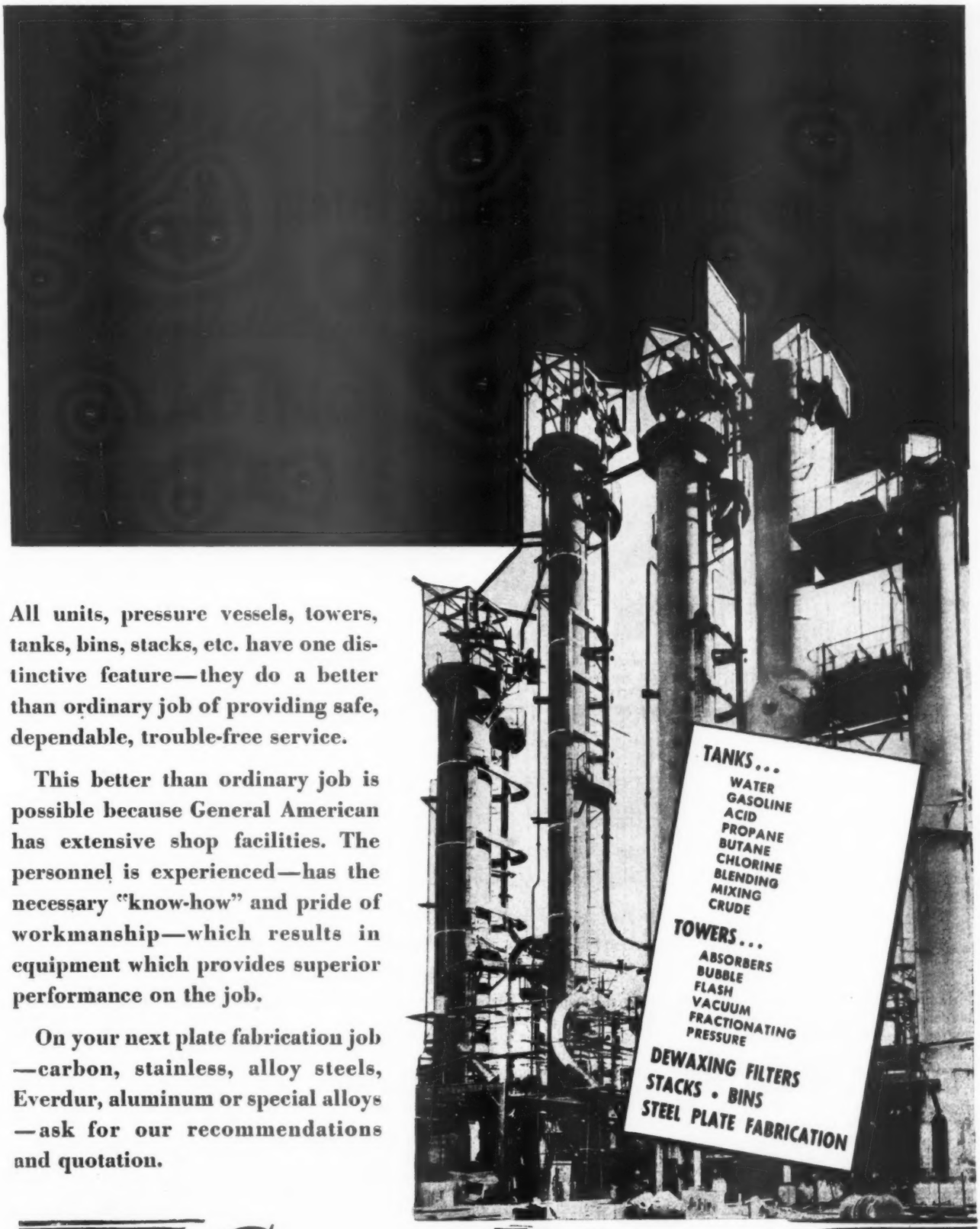


FIG. 2. Section shows how gas from header enters an elbow connecting the air manifold to the cylinder head.



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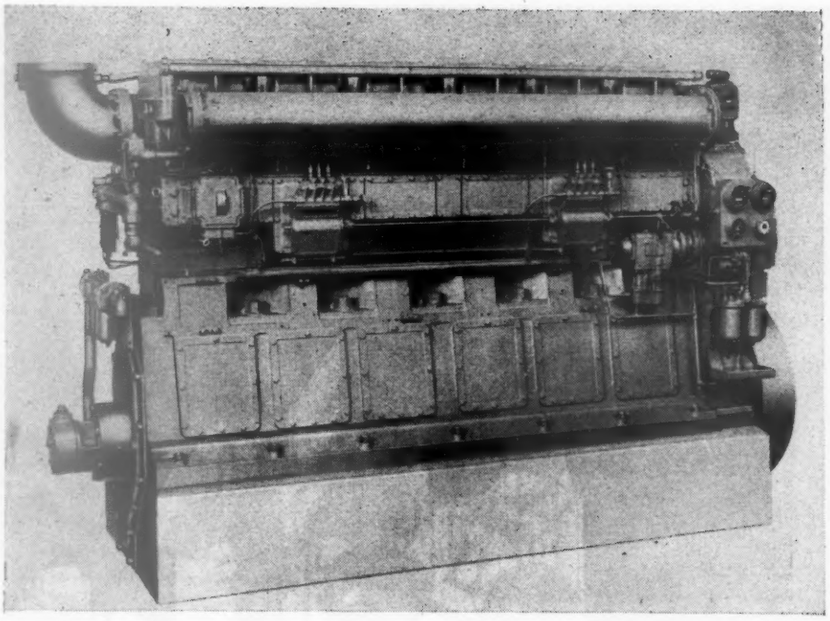


FIG. 3. One of the two atmospheric gas-diesels now driving oil pumps on Stanolind's crude line in the Rangely field. Rated 770 hp. at 450 r.p.m.

charged gas-diesels differ in shape from those of atmospheric engines. Supercharged engines show lower fuel consumption not only at full but at partial loads also, being always lower than the atmospheric engine, even at the same bmep. Fig. 5 illustrates typical performance curve for supercharged engine.

At 130 bmep. in Fig. 5, total heat consumption of this engine was only 6350 B.t.u. per b.hp.-hr., representing brake thermal efficiency greater than 40 per cent, based on the fuel's lower heating value, as is standard gas-engine practice. This may very well represent a record efficiency for a heat engine, although no particular attempt was made to break any records. The engine on which this test was run carried all its own auxiliaries. We now know that this figure can be improved and believe that a net heat

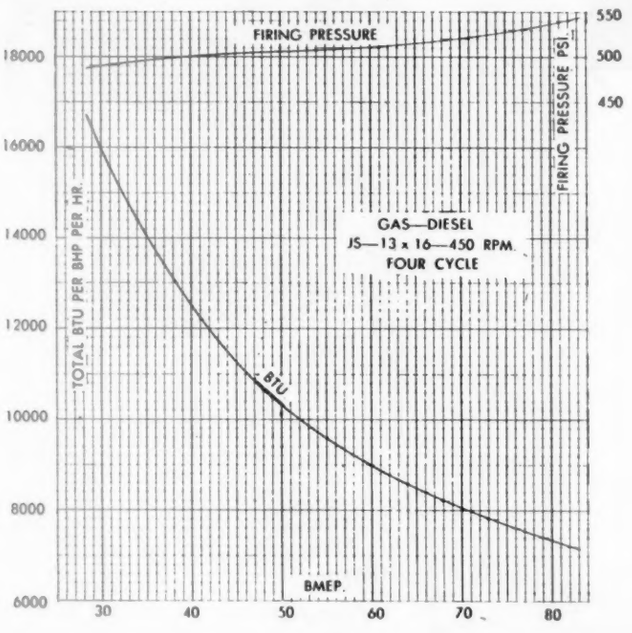
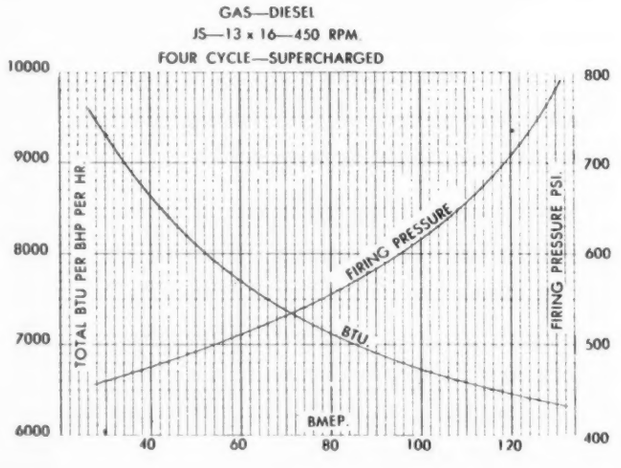


FIG. 4. ***Left*****—Net-heat-consumption and firing-pressure curves for atmospheric gas-diesel.**

FIG. 5. ***Below*****—Similar data for supercharged gas-diesel. Note that supercharging betters performance at any given brake mean effective pressure, particularly at low loads.**



formance. These fuel-economy data may be considered typical of the GS and LS engines, also available as gas-diesels.

Almost daily someone asks, "Can the gas-diesel be rated as high as the spark-ignited gas engine or as the conventional diesel?" Our experience shows that the gas-diesel can be rated as equal to the oil engine, and by arranging for an increased amount of fuel oil for overload conditions only, it is capable of much greater overloads than the normal diesel. We currently rate the atmospheric gas-diesel at 80 lb. per sq. in. bmep.*

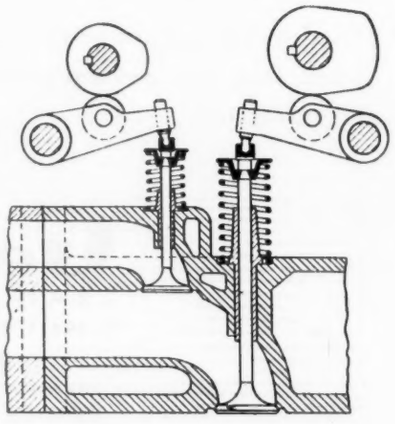
Applying the gas-diesel principle to a supercharged engine requires somewhat more complication than in the atmospheric engine, for it no longer proves possible to admit gas by the simple means of Fig. 2. In supercharged engines both inlet and exhaust valves are open during the scavenging period, and air under pressure blows through the cylinder into the exhaust system to clear out unburned gas. If fuel gas were admitted in the simple manner of Fig. 2, some would be carried through the cylinder and out the exhaust unburned.

It is, therefore, necessary to time gas admission so it begins about the time the exhaust valve closes and all the gas is trapped in the cylinder. For that purpose we employ a gas timing valve, shown diagrammatically in Fig. 6, which is operated by the inlet and exhaust cams but which injects gas into the intake air stream rather than into the cylinder. Foreseeing the necessity of this timing, we applied for and received a patent covering this in general. Fig. 7 shows a typical supercharged engine, one of several sizes now available.

Fuel-consumption curves for super-

*Brake mean effective pressure.

FIG. 6. Diagram shows how timing valve controls gas admission to inlet air stream so no fuel is wasted by entering cylinder during scavenging.



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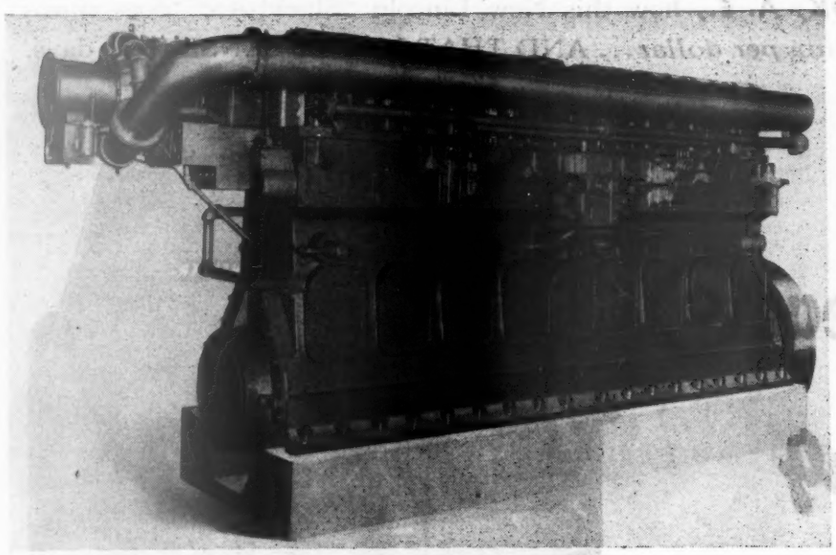


FIG. 7. This supercharged gas-diesel is rated at 1570 hp. for 327 r.p.m.

rate of 6000 B.t.u. per b.hp-hr. is entirely possible.

As with the 4-cycle atmospheric engine, recommended ratings for supercharged gas-diesels run the same as for supercharged oil-diesels. We currently rate them at about 115-lb. per sq. in. bmep. for heavy duty applications.

Two-cycle gas engines power a large percentage of gas compressors today. Pipe line engineers find attractive the possibility of conserving fuel by higher engine efficiency and also appreciate the ability to convert engines to oil fuel in winter when gas supply is low. To meet this need, we carried 2-cycle development along with 4-cycle.

The 2-cycle gas-diesel presents the same timing problem as the supercharged 4-cycle and an additional scavenging problem. Although we consider our development of the 2-cycle gas-diesel as far from complete today, we have built some engines and include here a report on this type to answer the many questions that arise.

Our standard gas-engine practice involves injecting gas into the cylinder at about the time exhaust ports close. As all air is already in the cylinder, the gas cannot be admitted with the air, and effectiveness of mixing depends entirely on gas velocity plus air turbulence. Thus, in the gas-diesel engine gas must be injected into the cylinder rather than into the air stream as in 4-cycle engines. Fig. 8 shows the novel arrangement that

FIG. 8. Arrangement for injecting fuel gas into cylinder of 2-cycle gas-diesel at end of scavenging period.

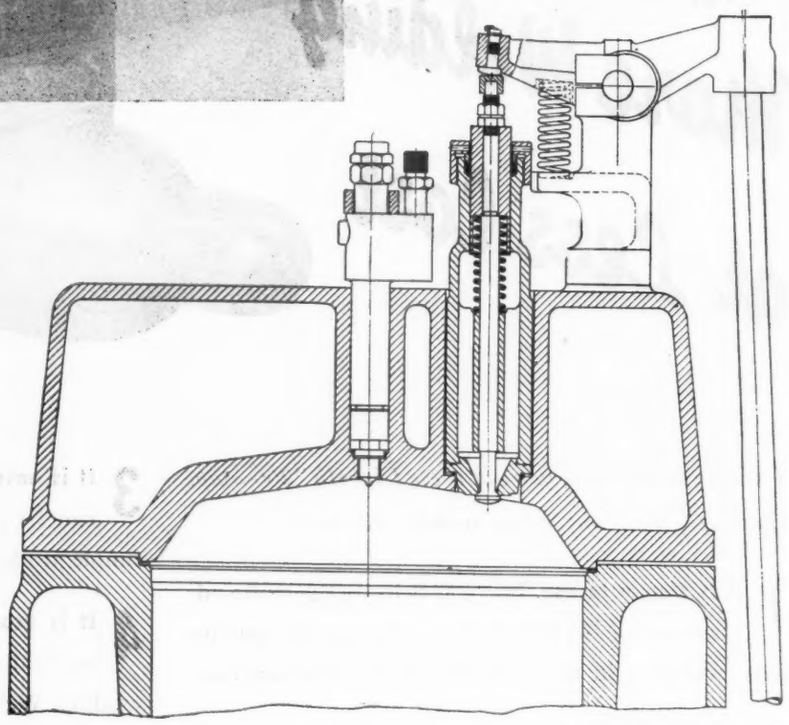


FIG. 10. Net heat consumption and firing pressure, 2-cycle gas-diesel. At any given bmep, performance betters 4-cycle.

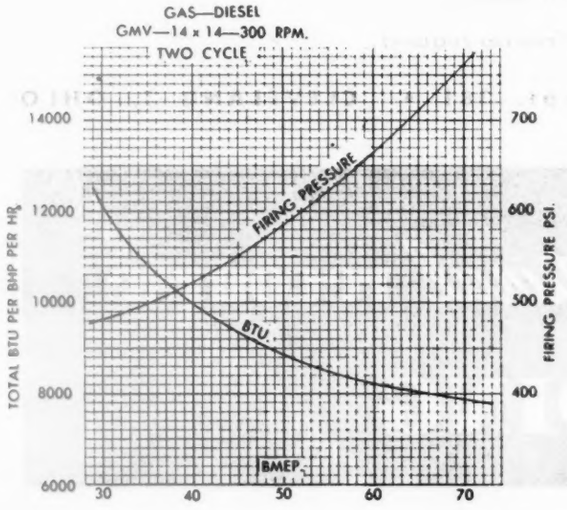
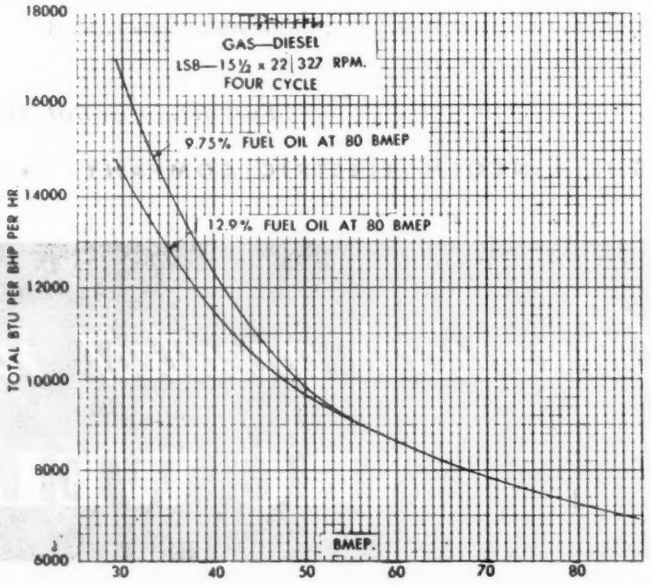


FIG. 11. Two runs on same engine with different fuel-oil percentages show that effect is felt most at lighter loads.



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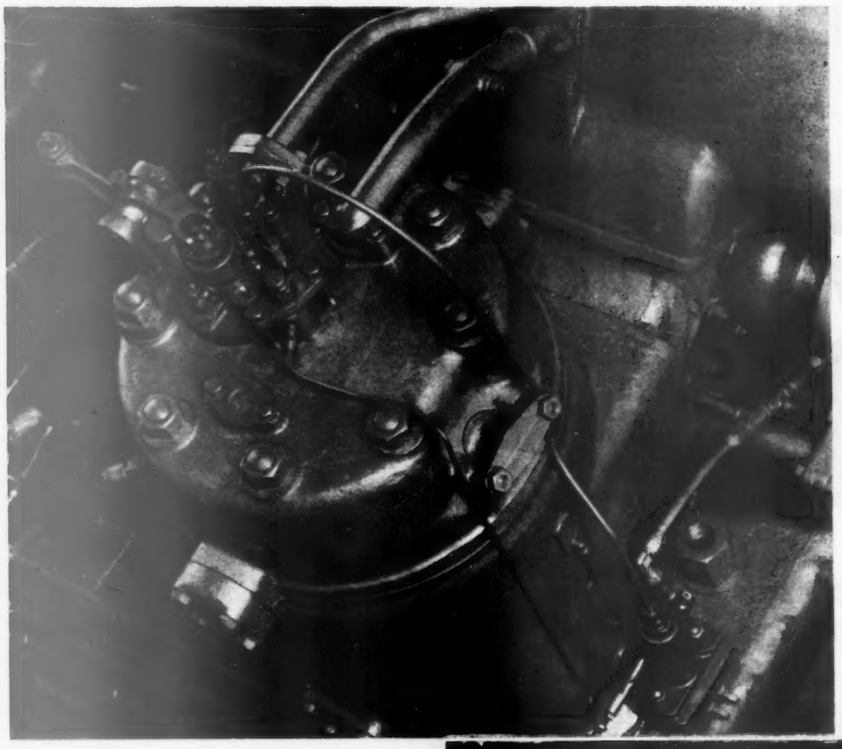


FIG. 9. Cylinder-head construction widely used in compressor stations.

accomplishes this, and on which patents are pending. Fig. 9 illustrates the cylinder-head construction of a 14-in. by 14-in. Type-GMV 2-cycle engine.

Fuel-consumption curves for 2-cycle engines display much the same characteristics as those for 4-cycle units. Fuel consumption at full load is higher than for 4-cycle engines but that is because the 2-cycle engine is rated at lower bmep. At any given bmep., 2-cycle performance runs better than that of 4-cycle atmospheric engines.

Fig. 10 shows a typical fuel-consumption curve for a GMV engine; normal rating is about 62 lb. per sq. in. bmep. At the present stage of development it is entirely possible to carry that rating with some overload capacity and without any detonation. To do it, however, requires (1) a somewhat greater amount of scavenging air than normally used with a spark-ignited 2-cycle engine, or (2) a greater percentage of pilot oil.

If scavenging pressure runs too low or fuel-oil percentage is not high enough, the flame-propagation wave from the pilot injection frequently sets off a pocket of richer mixture due to stratification. Contrary to what one might expect, we have had no difficulty with preignition. By increasing air turbulence we have cut fuel-oil percentage to less than 4 per cent. On the other hand, by increasing fuel-oil percentage to about 20 per cent, normal full load can be carried with a minimum of scavenging and turbulence.

This matter of fuel-oil percentage has provoked much discussion. Actually, as little as 1 per cent pilot oil will fire the gas charge but that must be considered impractical with a normal fuel system. Percentage of fuel oil affects performance very little at full load and the gas-diesel is not sensitive to percentage differences down to about 75 per cent load. but the effect is definite at light loads.

Gas-air ratio runs much leaner at light than at full load and it finally becomes so lean that it will not propagate flame at all. Therefore a condition is reached at extremely light loads where the only part of the gas burned is that which comes in contact with the actual fuel-oil flame. For this reason the gas-diesel, though inherently highly efficient at normal loads, proves much less efficient than the oil-diesel at light loads, and may run even less efficiently than spark-ignition engines at very light loads.

It is this low-load portion of the curve that is sensitive to fuel-oil percentage. For example, consider the two curves of Fig. 11, run on Cooper-Bessemer 15½-in by 22-in. atmospheric diesel; below about 55 bmep. fuel-oil percentage is important, but above that point it has little effect on economy.

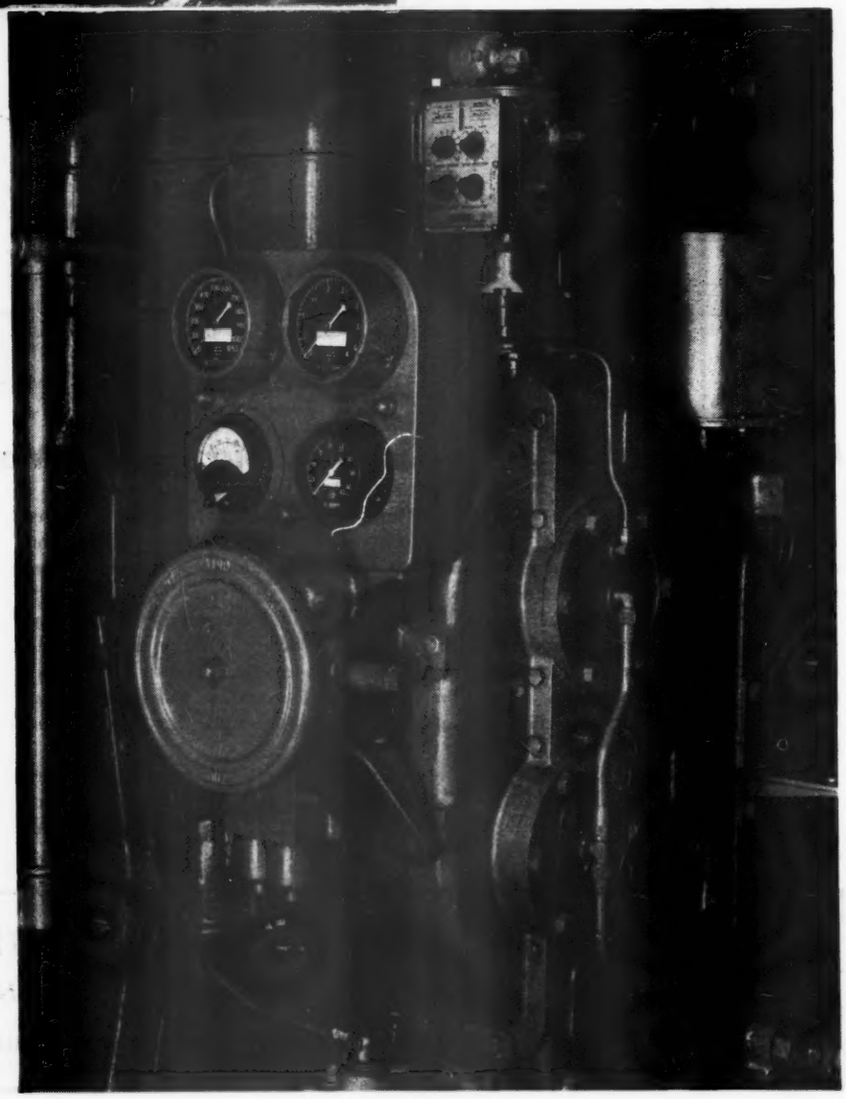
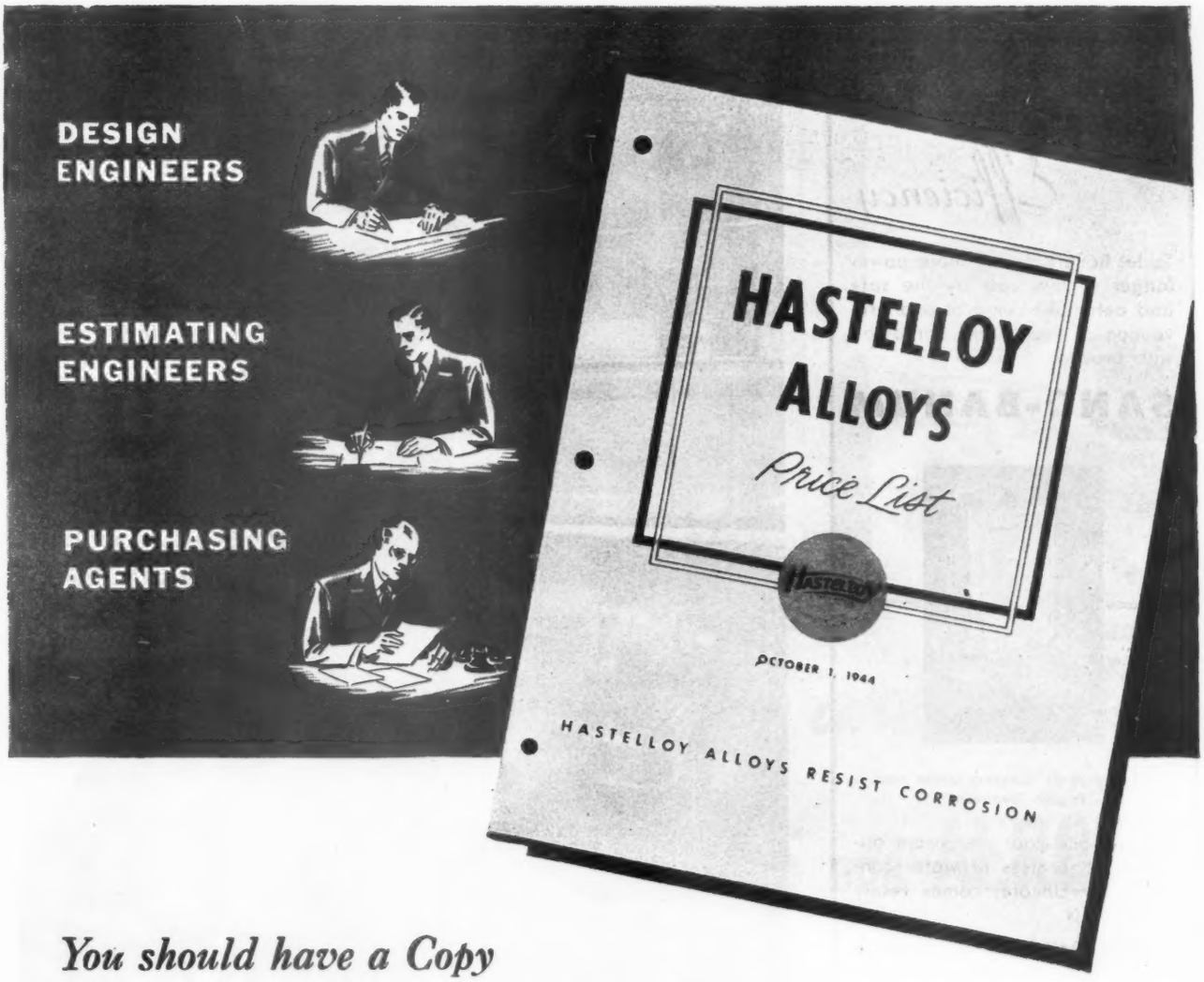


FIG. 12. Early control development led to system shown with handwheel for shifting from one fuel to another.



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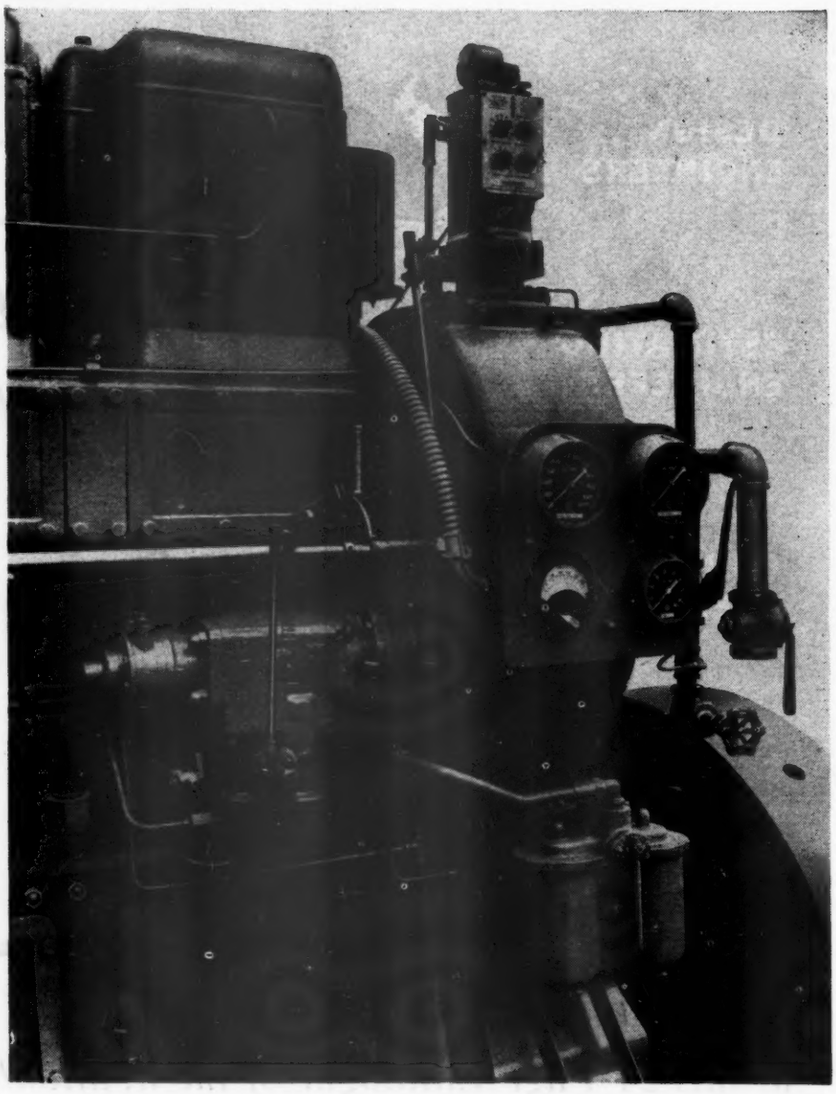


FIG. 13. Simplified form of control involves only addition of gas-regulating valve and linkage to governor; fuel-oil-control system remains unchanged. (Mechanism in Figs. 14, 15.)

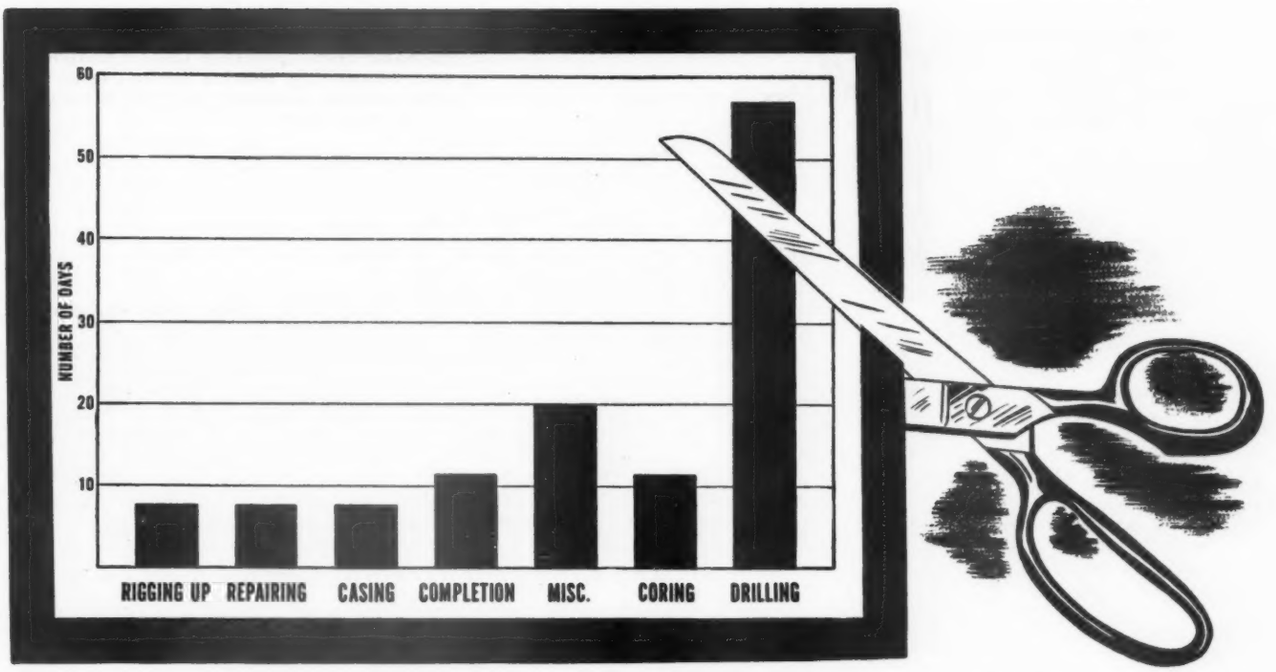
For an engine operating mostly at full or nearly full load, a low fuel-oil percentage proves desirable from a standpoint of economy — how low depends largely on the fuel-oil system. When we remember that it usually takes about 15 per cent as much fuel oil to operate an engine when idle as at full load, it becomes apparent that speaking in terms of 5 per cent the amount is scarcely enough to keep the engine firing. Allowing for fuel-oil system inaccuracies we consider it impracticable to think of using the normal fuel-oil system for less than 10 per cent fuel-oil delivery.

Fuel-oil percentages of less than about 10 per cent can be obtained by using an auxiliary injection system for the pilot oil, with smaller nozzles and pumps. To avoid difficulties arising out of the fact that one or the other set of nozzles may be inoperative for long periods, we recommend use of the normal fuel system and toleration of a minimum of 10 per cent fuel oil. This arrangement offers the further advantages of simplicity and lower gas consumption at light loads, where a higher fuel-oil percentage is preferable. (Fig 11.)

When it came to controls for the gas-diesel, we began somewhat elaborately with a handwheel control (Fig. 12), which made possible a change from gas to oil, or vice versa, with one turn of the wheel. Returning to our basic philosophy of effecting the change from diesel to gas-diesel as simply as possible, we devised the control in Figs. 13 and 14.

To understand how this control operates, assume an engine to be operating on oil, but with the governor connected to both the fuel-oil system and the gas-supply valve. If the operator opens the gas valve, the governor moves to about mid-position and the engine operates temporarily on both fuels. If the operator moves the fuel-oil control to the minimum or pilot position, the engine becomes a straight gas-diesel.

Switching back to operation as an oil-diesel merely reverses the process. Releasing the fuel-oil lever to full position causes the governor to take a mid-position again and the engine to operate temporarily on two fuels. Shutting



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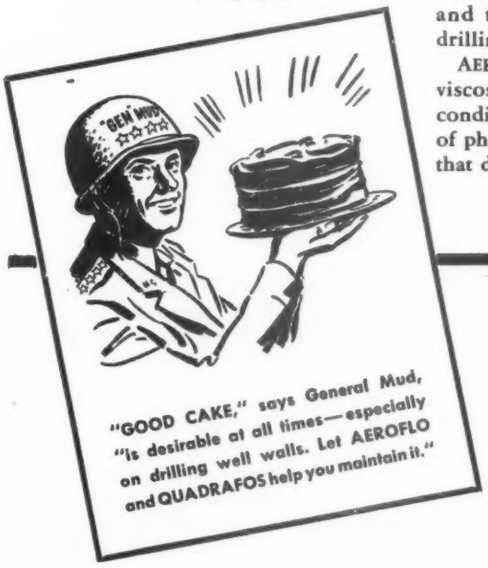
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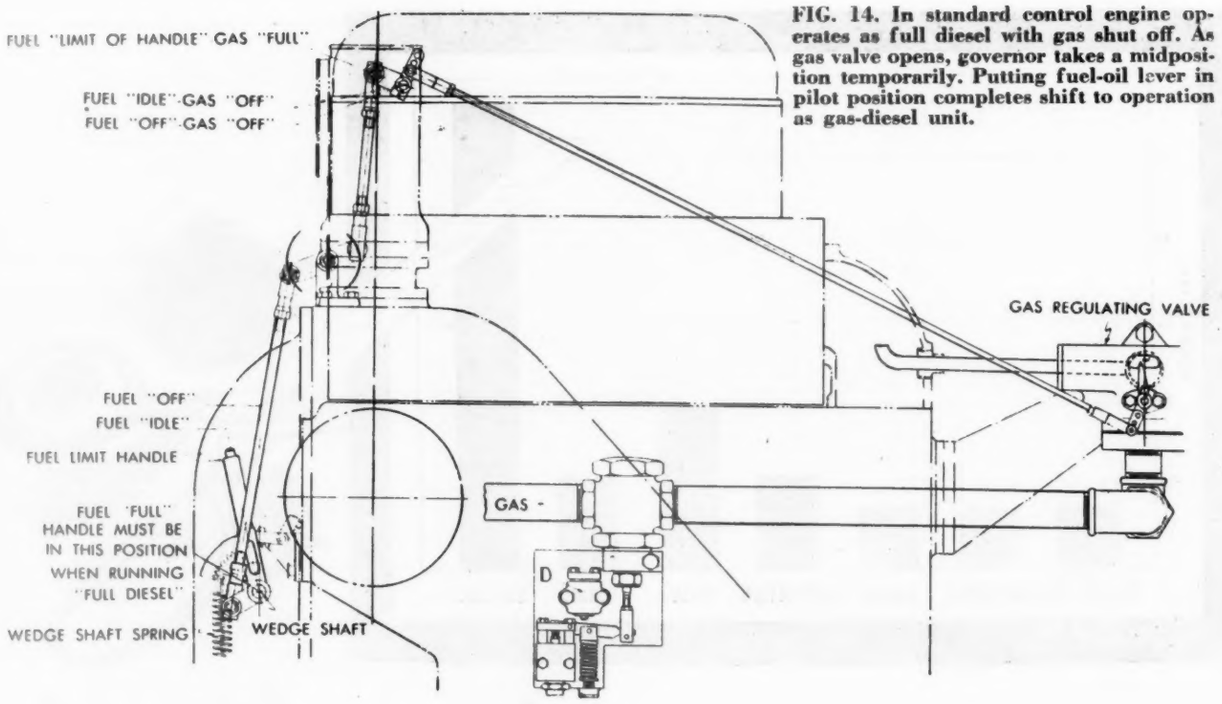

FIG. 14. In standard control engine operates as full diesel with gas shut off. As gas valve opens, governor takes a midposition temporarily. Putting fuel-oil lever in pilot position completes shift to operation as gas-diesel unit.

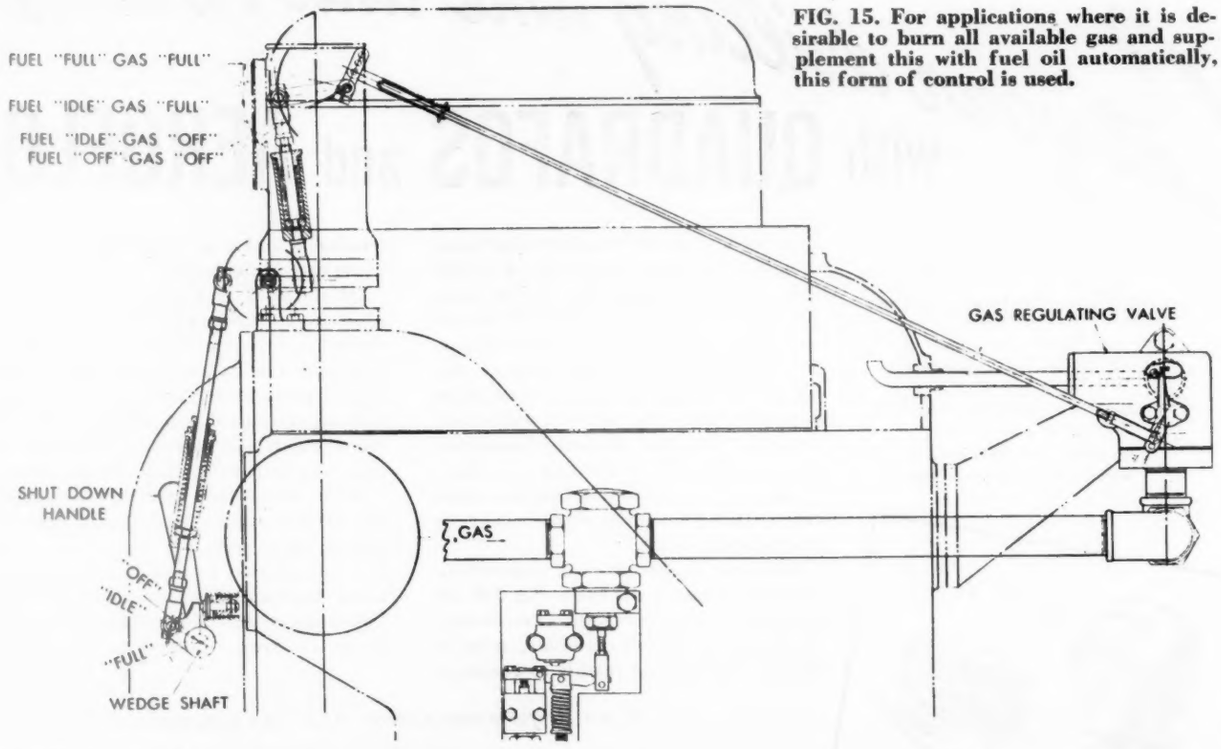

FIG. 15. For applications where it is desirable to burn all available gas and supplement this with fuel oil automatically, this form of control is used.

off the gas valve throws the unit back to oil-diesel operation. Thus this system adds only a gas valve and link to the existing governor and leaves the fuel-oil system exactly as it was originally.

This simple control system meets almost all installation requirements but occasionally the gas supply is questionable and may fail, or partly fail, at any time. In such cases, the operator wants an engine that operates as fully as possible on gas, automatically supplemented by oil as required. A simple adaption of **Fig. 14**, shown in Fig. 15, makes this possible.

With this system, the first half of governor travel is on gas and the latter half is on oil. So long as gas is available to meet the load requirements the governor controls the engine by operating in the first half of its travel. If gas supply fails, the governor, attempting to keep the engine from dying, moves into the second half of its travel, thereby opening up the fuel oil. The engine continues without interruption. This system, and that of Fig. 14, offers the advantages of simplicity, freedom from need for adjustment, and low first cost.

The valve in the gas line ahead of the governor control valve (Figs. 14 and 15) is a safety feature. It is controlled by (1) overspeed and (2) fuel-oil pressure. In this way gas is shut off in case pilot-oil injection should fail for any reason.

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PART 4—FLOW

● **Preface.** Present day petroleum specifications require precise measurement and control of rates and quantities of product streams to and from the process units. Only by accurately controlling these rates can the quantity production of quality products be assured.

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Flow measuring instruments are used to a great extent to determine operation and production costs. These requirements add materially to the general instrumentation of the process units. It is self evident that when dealing with throughput in thousands of barrels per day, substantial savings are effected by the proper selection and application of flow measuring instruments.

● **Discussion.** At the Socony-Vacuum Paulsboro Refinery, the differential pressure type meter is generally used for flow measurement and control due to its inherent flexibility of application. Flow is measured in line sizes from ½ in. to approximately 36 in. with pressure and temperature ranges of the measured medium being practically unlimited.

When varying flow conditions require a change of meter range, this may be readily accomplished in the field.

When properly installed, the error over the active scale range of the differential type meter should not exceed plus or minus 2 per cent, although unfavorable operating conditions may induce greater inaccuracies. It is possible, however, to calibrate the instrument and intergrator so that an error of less than 1 per cent will exist over the working range.

There are other types of meters, such as the volumetric displacement meter, for which accuracies as high as one-tenth of 1 per cent are claimed by the manufacturer. These meters have their place in many refinery measuring applications; however, they do not afford the flexibility of the differential meter.

● **Primary elements.** As the flow through the primary element produces the pressure differential utilized to actuate the meter, it is important that the selection and design of this element be given careful consideration.

The 3 primary elements generally used for flow measurement may be classified as follows:

(a) The thin plate orifice.
(b) The flow nozzle.
(c) The Venturi tube.

The pitot tube being a primary element also deserves mention. As this device is generally limited to test work in the Paulsboro Refinery, we will consider its design and uses later.

Alfred Krieg

These primary devices are available in various forms and are used for specific qualities, which will now be discussed.

● **Thin plate orifice.** The concentric type thin plate orifice (see Fig. 39) has been universally accepted by industry as the most practical primary element for use with the differential type flow meter. Its use exceeds by many thousands that of the flow nozzle and Venturi tube.

The publication of reliable data on the subject makes possible the design of orifices for the accurate measurement of practically any fluid, and the data accuracy has been proved in thousands of applications of flow measurement and control.

The accuracy of the thin plate orifice when used for fluids and for operating conditions to which it is adapted compares favorably with the other commercial primary devices when not individually calibrated.

An outstanding advantage of the thin plate orifice is its flexibility. Refinery process flow applications are subject to seasonal or process capacity changes, and, in some cases, it is necessary to effect these changes at the primary device. The plate orifice is easily installed between existing pipe flanges, and can therefore be removed for inspection or for size alteration or replacement with a minimum of interruption to line service.

The low cost of initial installation or for replacement or alteration is another item for consideration. At the Paulsboro Refinery many of the plate orifices in use are designed and made in the instrument department. Data for making an orifice are supplied by the instrument engineer. The material, usually monel or stainless steel, is cut to the required outside diameter on a sheet metal disk cutter, and then finished in the shop lathe. Obviously, when the required facilities are available, substantial savings are effected by this system. When time is limited, such as during a shutdown period, it is easy to realize the advantages in making orifice changes within the plant instrument department.

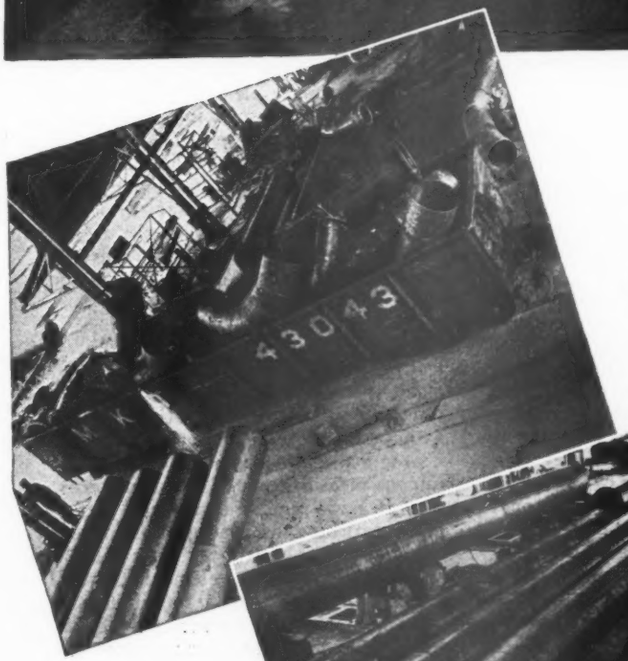
Permanent pressure loss is higher on orifice installations than with the flow nozzle or Venturi tube. This is caused by the abrupt change in direction that the flowing fluid must undergo as the stream approaches the orifice. After passing through the opening, the stream expands until finally the normal uniform flow is attained. This action creates considerable turbulence in the annular space at the orifice and results in a relatively high pressure loss. Where permanent pressure loss is a serious factor, it can in most cases be held within certain limits by use of the proper differential and orifice ratio.

When estimating pressure losses using the conventional graph or curve, it should always be remembered that meter installations are generally designed so that normal operation is much less than maximum capacity, and the actual operating loss will be considerably less because of the square relationship between differential pressure and velocity.

Plate orifices are made in 3 types: Concentric, eccentric, and segmental. (See Fig. 39). The concentric orifice is the most widely used for the flow measurement of clean fluids; however, when the material contains solids in suspension, there is a tendency for these solids to deposit on the upstream edge of the orifice, causing erroneous readings. The eccentric and segmental types of orifices are available to permit the free passage of solids through the opening. Special design and calibration on these types are desirable.

There are many types of primary devices, designed for a variety of applications: The hat orifice, orifice holders and carrier rings, precision orifice measuring units or assemblies, and special assemblies and orifice holders for small pipe. (See Fig. 40). Also available are the special devices such as the orifice fittings for quick change of orifice under pressure and the precalibrated, adjust-

*Alfred Krieg is supervisor of Instrument Department at Socony-Vacuum's Paulsboro, New Jersey, refinery.



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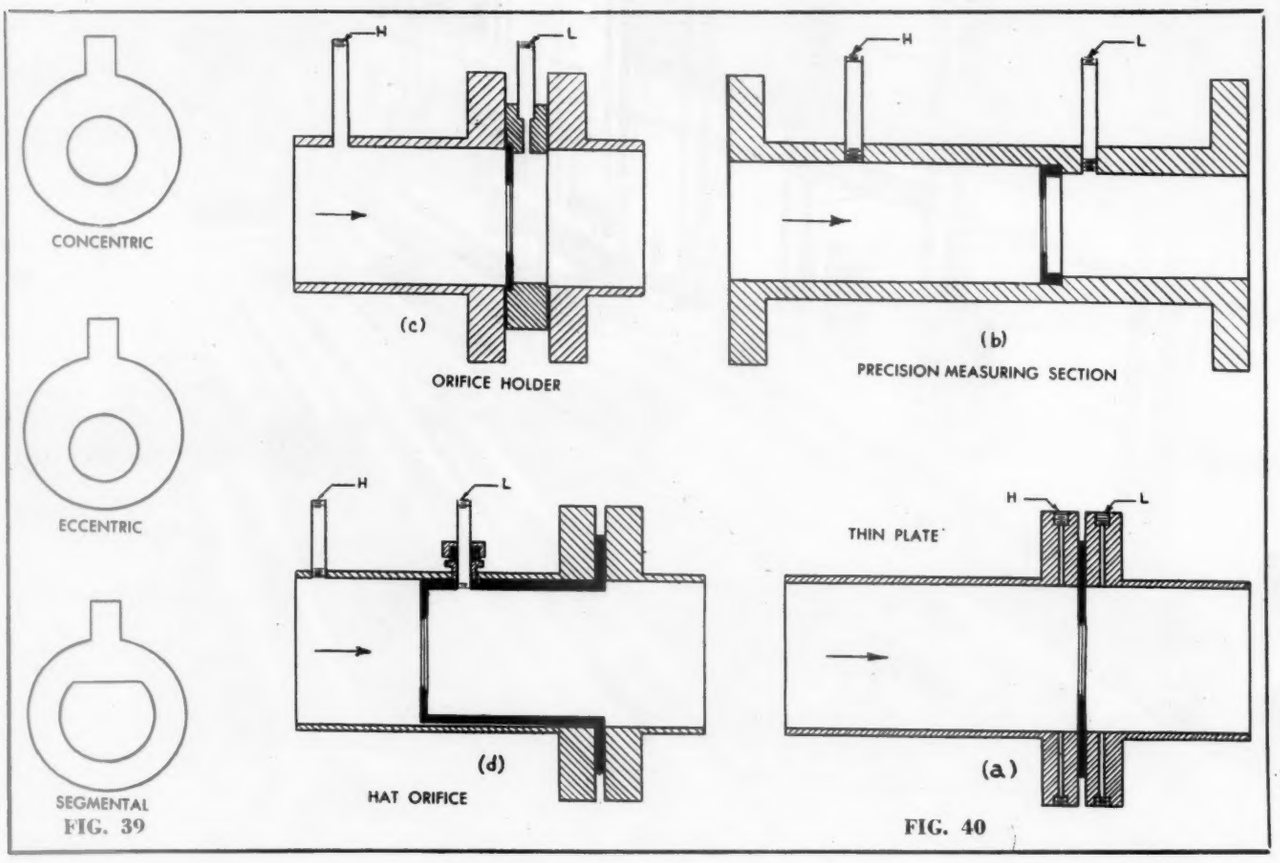


FIG. 39

FIG. 40

able orifice assembly. Space limitations will not permit a general discussion of the uses of all these devices, which are described in detail in many manufacturer's catalogs.

● **The flow nozzle.** The flow nozzle, (Fig. 41 A and B) has approximately 60 per cent greater capacity for a given throat diameter than the thin plate orifice due to its streamline approach. This makes its use desirable where high flow conditions exist, and where the expense of the Venturi tube is not justified. Compared with the orifice plate there is a small increase in the pressure recovery when the 2 devices are designed for the same rate at the same differential. It is especially suitable on high velocities and on fluids containing sediment.

It is installed between 2 pipe flanges in the same manner as the thin plate orifice; however, because of its design, it cannot be changed or inspected as easily as the orifice plate.

Flow nozzles are made of various metals depending on the service demands. For small pipe installations they are spun from light sheet metal and in the larger sizes are machined from castings.

● **The Venturi tube.** The Venturi tube (Fig. 42) was the first of the primary devices to gain widespread acceptance as a measuring element. Its greatest advantages are: High accuracy, high pressure recovery, and the ability to pass fluids containing a high percentage of sediment or solid matter.

When carefully made and calibrated the Venturi tube is highly accurate at any pressure and at capacities that are limited only by the size of the pipe in which it is installed. The accuracy of the thin plate orifice is higher at low rates of flow, whereas the Venturi attains its highest degree of accuracy at high flow rates. Its design is such that the stream of fluid is gradually guided through the constricted area or throat of the tube without the turbulence inherently created at an orifice installation. This results in a very low pressure loss across the section thus permitting a greater quantity of material to pass.

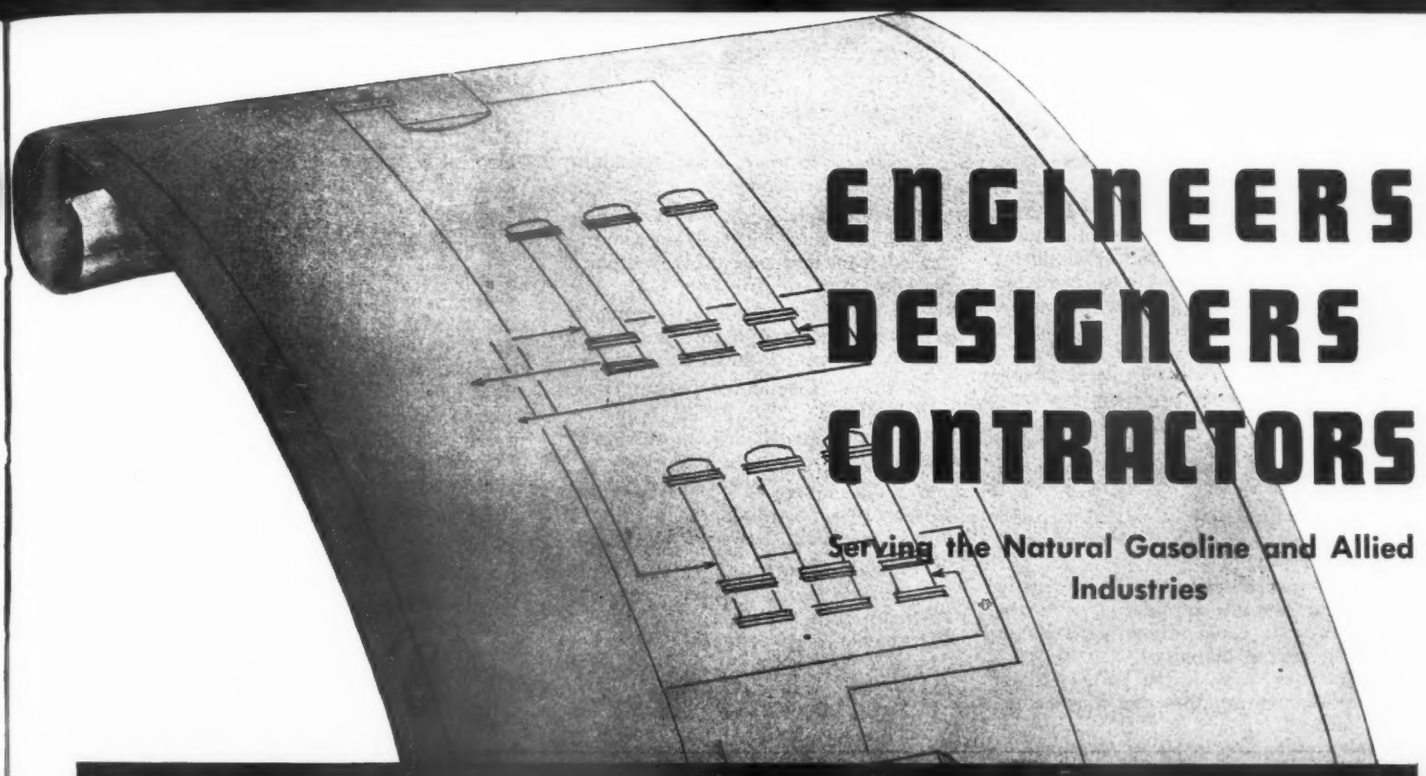
It is particularly adapted to measuring fluids containing solids or sediment such as sewage or slurries. It is often necessary in such cases, however, to use a tube of such design that the differential taps are connected directly into the tube and to use some form or purge to keep the taps clear of solid matter. Corrosive fluids and chemicals can be measured if the tube is made of the proper material. Tubes of steel, cast iron, bronze, lead, and the glass lined metal tubes are available from manufacturers.

The initial installation cost of the Venturi tube is very high in comparison with the flow nozzle or thin plate orifice. Tubes are accurately cast in some cases, and for some applications are precision machined for greater accuracy and then carefully calibrated before installation, which adds substantially to the cost. On the larger size lines the tube sections are bulky and unwieldy for handling and changes to the Venturi tube are expensive. There are cases where the cost of installation of the Venturi tube is warranted by the economy effected by a decrease in pumping costs over a long period of time due to its high pressure recovery.

● **The Pitot tube.** The Pitot tube (Fig. 43) is a primary element that employs the difference between the impact and static pressures to obtain the velocity of the fluid from which the flow is calculated. For an accurate determination of the rate of flow it is necessary to obtain the ratio of the average velocity to the center velocity of the fluid by a traverse with the Pitot tube. Accuracy is greater at the higher velocities than on low flow rates.

The Pitot tube is widely used as a testing device when it is required to make spot checks of fluid flows. It is a portable instrument, easily installed without interruption to service, making it practical and economical when a continuous measurement of flow is unnecessary. In large pipe or ducts where orifice or Venturi tube installations are impracticable and expensive, the Pitot tube is an effective measuring element. In commercial use, however, it is limited to ideal flow conditions where the flow is steady, the fluid clean and of low viscosity. As the aperature on the Pitot tube is of necessity small, it cannot be used on fluids containing any matter that might enter the element and affect its accuracy.

The inflexibility of this device limits its commercial use. At the existing velocity in a certain sized pipe, it is capable of producing only one differential, and



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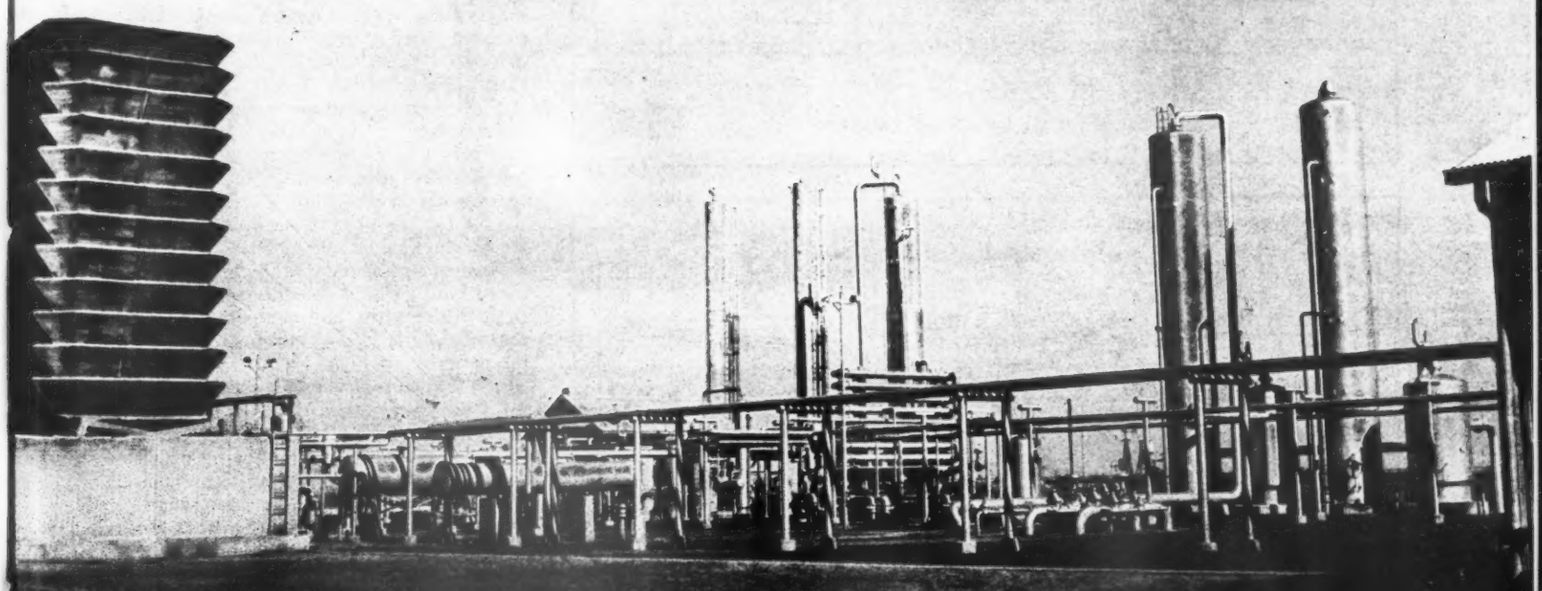

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this is often too low for measurement on available differential meters.

● **Primary devices summarized.** If one primary device met all the requirements for flow measurement, the development of the numerous types now available would have been unnecessary. Each of the types previously discussed has its distinct advantages in design for specific applications that will now be summarized. In selecting the proper primary device for a given flow application, the important factors to be considered are: Accuracy, cost, flexibility, efficiency, and resistance to wear.

● **The orifice plate.** *Cost:* Low cost—can be purchased inexpensively or made in the shop lathe.

Flexibility: Excellent flexibility, easily installed, altered, or replaced.

Accuracy: Good when used within specific ratio d/D limits.

Efficiency: Low. Lower percentage of pressure recovery than the flow nozzle or Venturi.

Resistance to wear: Low resistance to abrasive materials. Obstructs passage of dirt or sediment.

● **The flow nozzle.** *Cost:* High cost compared with orifice but lower than Venturi tube.

Flexibility: Fair flexibility—not easily installed or replaced.

Accuracy: Good, especially on high ratio d/D and velocities.

Efficiency: Good, greater pressure recovery than with orifice plate.

Resistance to wear: Good. Reliability on dirty service is good.

● **Venturi tube.** *Cost:* Very high initial and replacement cost. Must be purchased from flow measuring equipment manufacturer.

Flexibility: Poor flexibility—cannot be easily changed and in the larger pipe sizes is awkward to handle.

Accuracy: Considered most accurate unit available.

Efficiency: Excellent—approximately 88 per cent pressure recovery.

Resistance: Very good due to smooth surfaces. No obstruction to passage of foreign material.

● **Straightening vanes.** Valves, regulators, elbows, tees, and swages in a line upstream from an orifice will cause a disturbance or turbulence in the flow that causes inaccuracies, particularly in gas measurement. Such a source of error can be eliminated by having a sufficiently long length of straight pipe without fittings of any description upstream or ahead of the orifice. If this is not possible, straightening vanes must be inserted in the pipe to make the installation suitable for measurement. (See Fig. 44). The purpose of straightening vanes is to nullify the turbulences, such as swirls, cross-currents, and eddies created by fittings before the liquid reaches the primary element. Five to six diameters of straight pipe are required between the straightening vanes and the primary element regardless of the type of fitting that creates the turbulence.

Straightening vanes are made of metal in various forms to parallel the flow to the axis of the pipe by dividing it into small streams. The vane as a unit is tack welded into the line to prevent its changing position.

● **Pulsating flow.** On some measuring applications it is at times found that the fluid has an unsteady or pulsating flow caused by reciprocating pumps or by process system pressure fluctuations. Any differential pressure instrument installed where such a condition exists will invariably give high measurement errors. Little or no positive data for the elimination of this condition is available although it has been found that the error may be reduced by several methods:

(a) Stabilize the pressure insofar as possible by installing the orifice as far from the pulsation source as conditions permit.

(b) Install an additional orifice approximately 25 pipe diameters ahead of the metering orifice. (In extreme cases it may be necessary to install 2 such orifices). This method will, of course, produce additional line pressure drop, and the orifice should be designed to produce a minimum drop of 3 lb.

(c) An air chamber installed in the line will smooth out the pulsations. This method has been found most effective on fluid measurement. The air chamber may be installed along the pipe; however, one of the most effective points is in a vertical position at the pump discharge. Some method of injecting air into the chamber must be provided when required if this method is to be successful.

● **Flow meters.** Differential pressure flow meters may be classified under 2 general types, the mechanical and the electrical. The mechanical type transfers the differential pressure from the manometer to a flow reading on the chart or scale by a direct mechanism, whereas the electrical type makes use of one of several electrical methods to accomplish the transmission. Both of these instruments have specific design characteristics and inherent principles that warrant consideration in selecting and applying them for a given job.

Flow meters that are actuated by a constriction or a primary element to produce a drop in pressure in a pipe are classified as differential or head meters. As they measure the rate of flow of the fluid at the primary section, they are also designated as rate meters. This type of instrument is adaptable for almost every kind of fluid measurement at unlimited pressures and temperatures as the metered fluid does not pass through the meter.

● **"U" type manometer.** The simplest form of the pressure differential measuring device is the manometer. It is made in various shapes or forms among which the "U" tube style is the most common. (See Fig. 45). It may be used for ranges of pressure and temperature within the design limits of the glass of which the tube is made. Mercury, carbon tetrachloride, and water are the usual filling me-

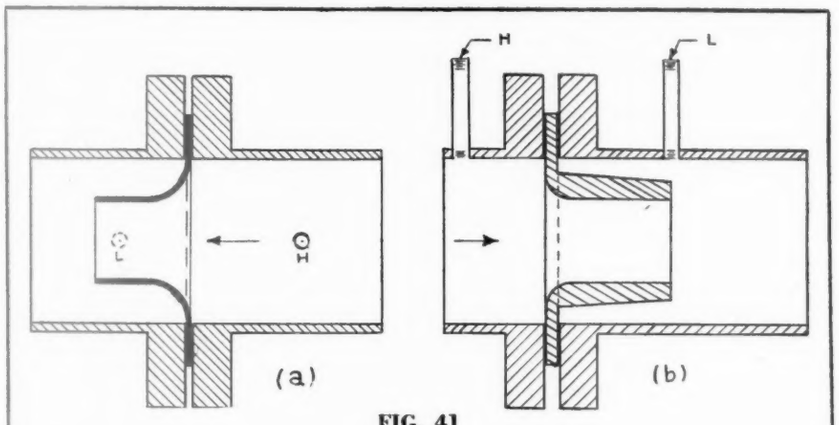

FIG. 41

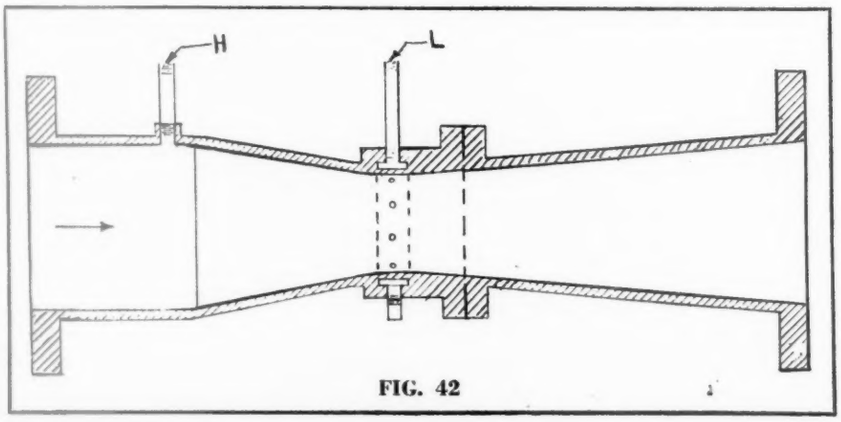

FIG. 42

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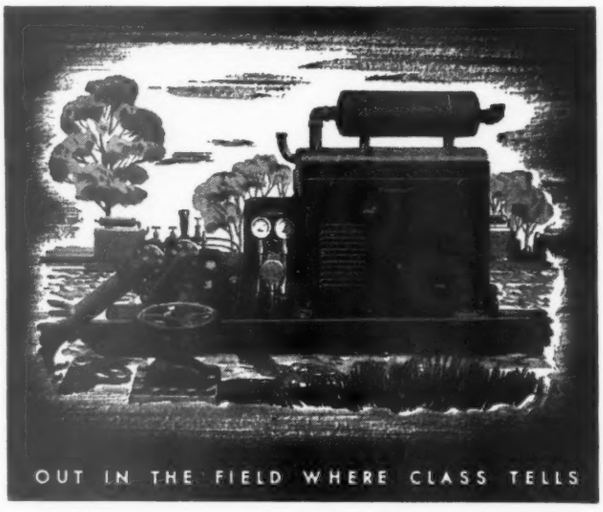

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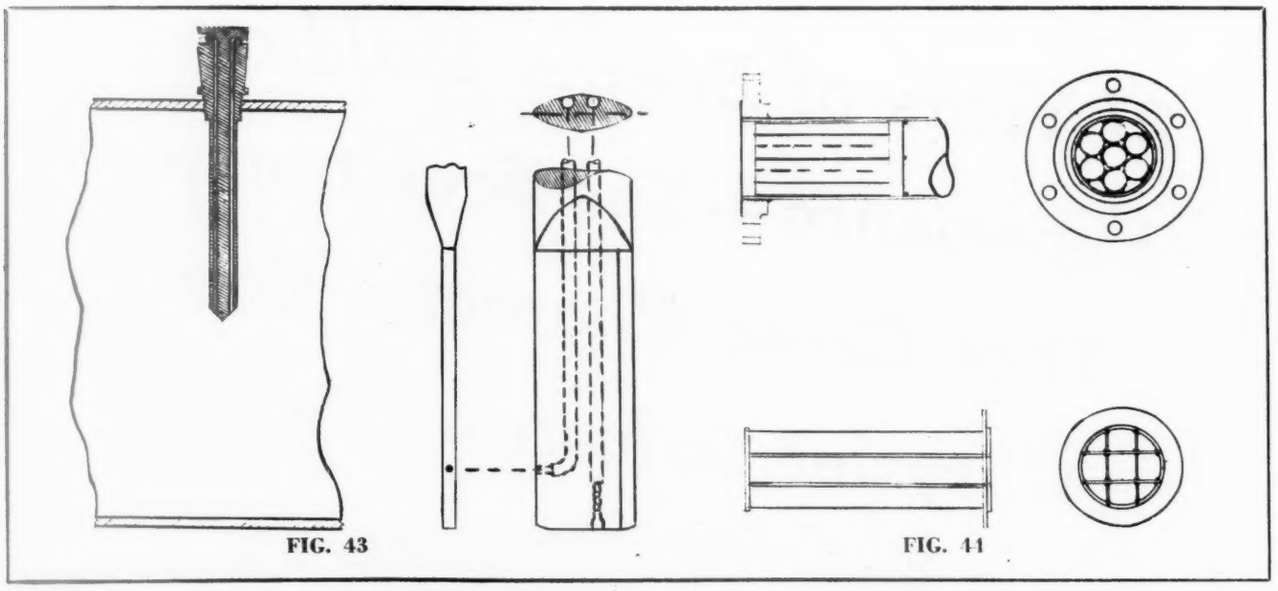

FIG. 43

FIG. 41

diums, depending on the velocity and gravity of the fluid being measured.

The manometer is a very accurate measuring device if the glass tubing has a uniform bore and the readings are carefully taken. It is easily connected and is portable, however, the disadvantage is the inherent fragility of glass where water hammer and thermal shock may occur, which is objectionable from a standpoint of safety. Although many of these devices are permanently applied, they are also used to a greater extent for test purposes. It is the most inexpensive of flow measuring devices.

● **Differential meter.** *Mechanical lever arm type.* For the most part all recording and indicating flow meters of the mercury filled type are, in one form or another, a modification of the simple "U" tube manometer. They are designed with the high and low pressure legs of different diameters and contours, with the leg containing the float mechanism being fixed in contours, whereas the other leg, termed the range tube, is of any given diameter to meet a specific flow condition. (See Fig. 46A). Most manufacturers of flow meters supply a series of interchangeable range tubes for their particular meter, varying in diameter to give ranges of pressure differential from 1.0 in. to more than 200 in. of water.

The simplest of mechanical meters consist of a manometer, containing a float chamber for one leg and a range tube or mercury chamber for the other, with the recording or indicating mechanism attached to an integral part of this manometer. The differential pressure is transferred from the manometer to a flow reading or indication on the chart by means of a pressure-tight shaft, one end of which is attached to a float mechanism and the other to the pen arm or pointer. When the manometer is operated under high pressure a certain amount of friction is introduced in the pressure-tight bearing in order to prevent leakage from the manometer into the instrument case. It is necessary that the differential float mechanism be of such design that it will be powerful enough to overcome this friction without too great an effect on the accuracy and the sensitivity of the meter.

The simplicity in the design of this type of meter is one of its outstanding features. The simple construction and the minimum number of parts in the meter assure low maintenance and initial cost.

Low pressure bell type. The mercury actuated manometers, which have been discussed thus far, have been designed for differentials from 20 in. of water to above 200 in., however, for low pressure ranges (1 in. to 20 in. of water differential) meters of this design would not be powerful or sensitive enough to operate the recording mechanism, for the maximum deflection in mercury level is only a fraction of an inch. A modification in design has solved this problem by the use of a bell floating in a single mercury chamber, as shown in Fig. 46B. Because of the large diameter of the bell, the power available is much greater and the travel is likewise multiplied, thus reducing the friction loss.

Other types. Under the general mechanical type of flow meters are several ingenious methods of transferring a differential in the manometer to the flow reading on the chart. One method makes use of a magnetic coupling or clutch, which eliminates the pressure-tight shaft between the manometer and the instrument case, thus preventing the possibility of any leakage.

The principle of the tilt balance is used in another type of mechanical flow meter. A "U" shaped tube is balanced on a knife edge and any differential in pressure across the "U" tube is reflected in a proportional tilting of the tube, which is transmitted to the flow pen. (See Fig. 46-C). The instrument must be rigidly installed and perfectly level in order to maintain its accuracy.

In all the previously discussed meters the pressure differential was measured by a mercury filled manometer of the "U" tube type. In the Aneroid type of instrument, a sensitive metal bellows that actuates a torque tube assembly measures or balances the differential pressure. Article 3 on Liquid Level, describes the use of the Aneroid manometer as a liquid level indicator or controller. The same type of instrument is used as a flow meter. (See Fig. 46-D).

The range of the Aneroid manometer may be changed by simply changing the torque tube assembly. It is particularly adapted for use on gas flow where condensation or moisture may be present in large amounts. Two connections in the meter body make it possible to drain any liquid that might accumulate without the necessity of draining mercury as in the mercury filled instrument.

It is more sensitive to small flow changes than the ordinary mercury filled manometer. This is because of the lack of the inertia effect, which is characteristic of mercury. Care must be exercised when cutting in, blowing down, or checking the meter in order to prevent a high differential pressure to build up across the bellows and damage it.

Force balance type. A differential pressure measuring element of the force-balance type uses a pneumatically operated differential diaphragm unit and weigh beam to measure and transmit the medium in units of flow, pressure, or liquid level to a receiver or recorder. (See Fig. 47).

One of the unique features of this system is the small motion required by the diaphragms or bellows in measuring and transmitting — thereby prolonging the life and accuracy of these vital parts.

A bellows arrangement encloses the beam or shaft in the pressure chamber, eliminating the stuffingbox, torque tube, or pressure bearing adapted for sealing purposes in other types of differential pressure measuring units.

Differential pressure ranges are available from 0-2 in. of water to 0-400 in. of water in working pressure ranges up to 2000 lb. per sq. in., and the diaphragm

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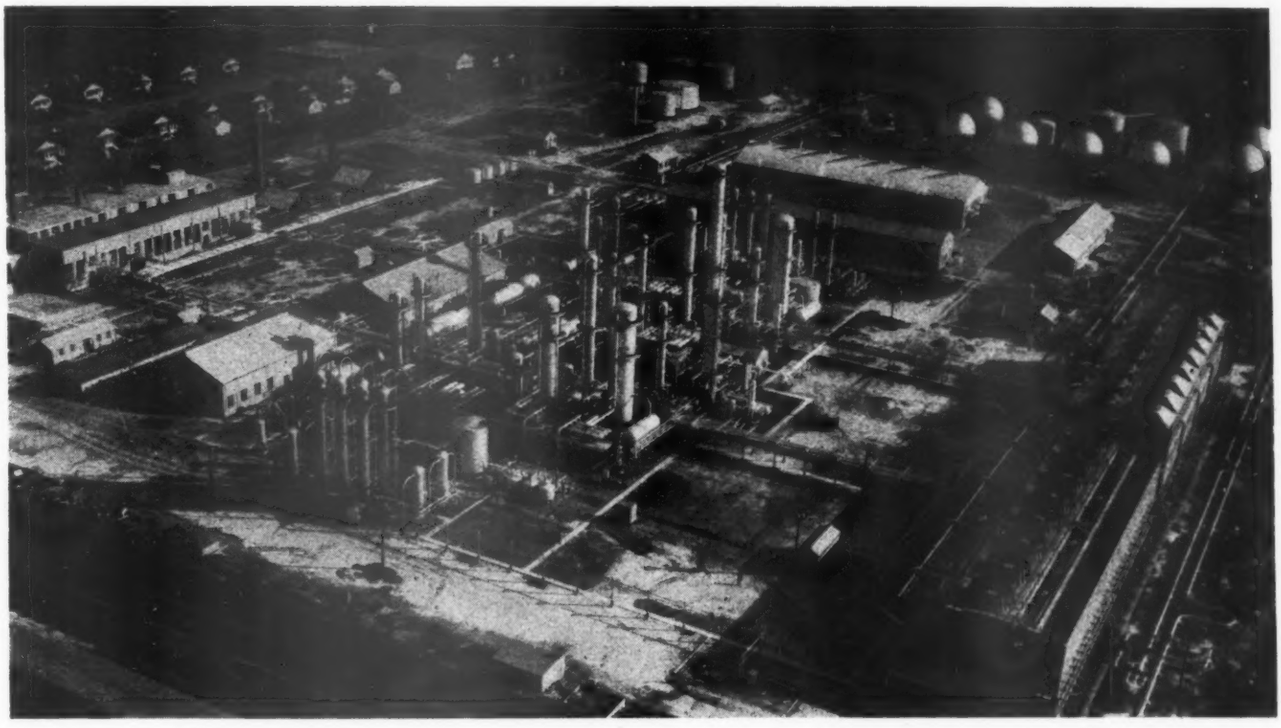

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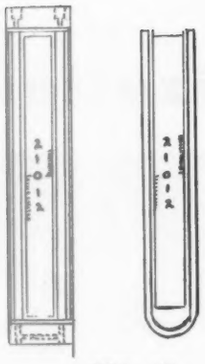


FIG. 45

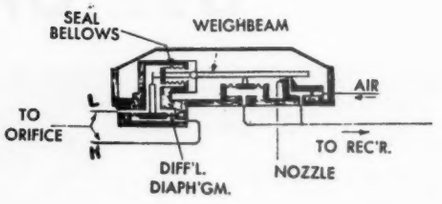


FIG. 47

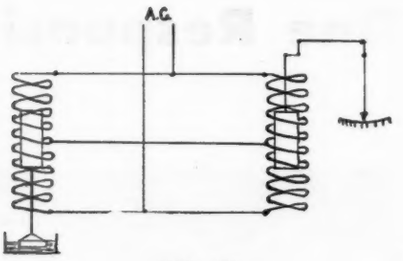


FIG. 48

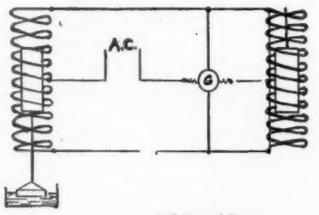


FIG. 49

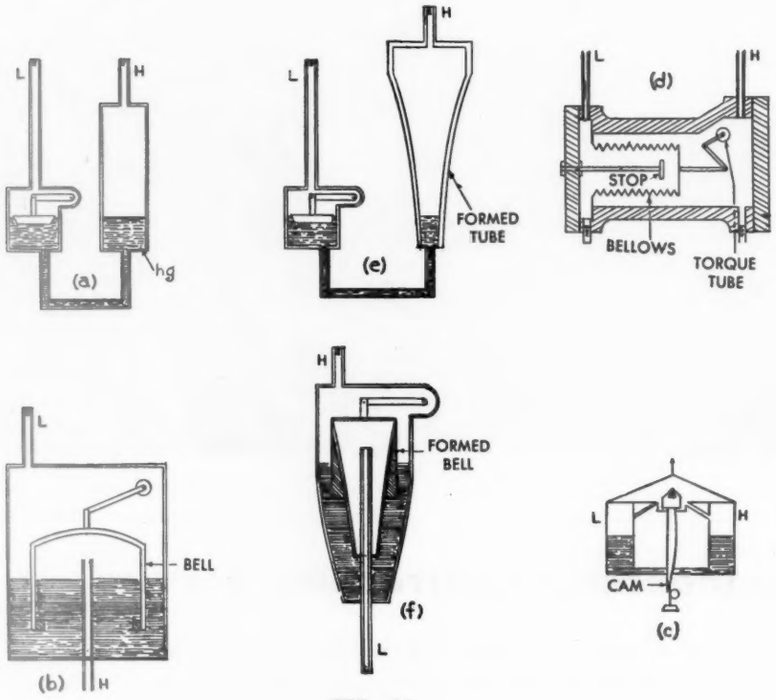


FIG. 46

materials are reinforced to withstand considerable overrange without damage. Ranges are easily changed by changing the reaction diaphragm position on the weigh beam, or by changing the diaphragm plates if required.

The standard range of the pneumatic transmitter pressure is 2-14 lb. per sq. in. to the receiver or recorder. This may be changed to suit required operating conditions or the receiver element.

Diaphragms, bellows, and parts in the measuring chamber are of corrosion-resisting materials to conform to various application demands.

● **Electrical flow meters.** *Inductance bridge type.* The inductance-bridge type electrically operated flow meter has many of the characteristics of the mechanical flow meter. It makes use of the "U" type manometer, mercury filled with a float mechanism and the conventional method of interchanging a leg of the manometer to change the meter range.

One advantage of this manometer (or transmitter, as it is designated by the manufacturer) is that there is no pressure-tight bearing or shaft arrangement required to transmit the float motion on the mercury to the recording pen. By using electrical power to transmit this motion, the friction and leakage of the pressure bearing are eliminated.

A divided inductance coil is placed in the recorder and in the transmitter, where a non-magnetic tube surrounds the core. (See Fig. 48). Inside the tube a soft iron armature attached to the float is free to move as required by mercury level changes. In the recorder case an identical armature is suspended from a balanced arm into the coil. Any motion of the float-armature causes an unbalance in the inductance bridge circuit, requiring a movement of the armature in the recorder coil and thereby through suitable linkage moving the pen arm until the mechanism has moved a distance equal to the motion of the float armature, resulting in a balance of the inductance-bridge circuit.

Another flow meter manufacturer uses the same inductance-bridge principle with a sensitive galvanometer connected into the circuit (see Fig. 49) to detect the bridge unbalance that sets in motion a motor-driven mechanism to reposition the core in the recorder coil to a position that rebalances the inductance-bridge circuit.

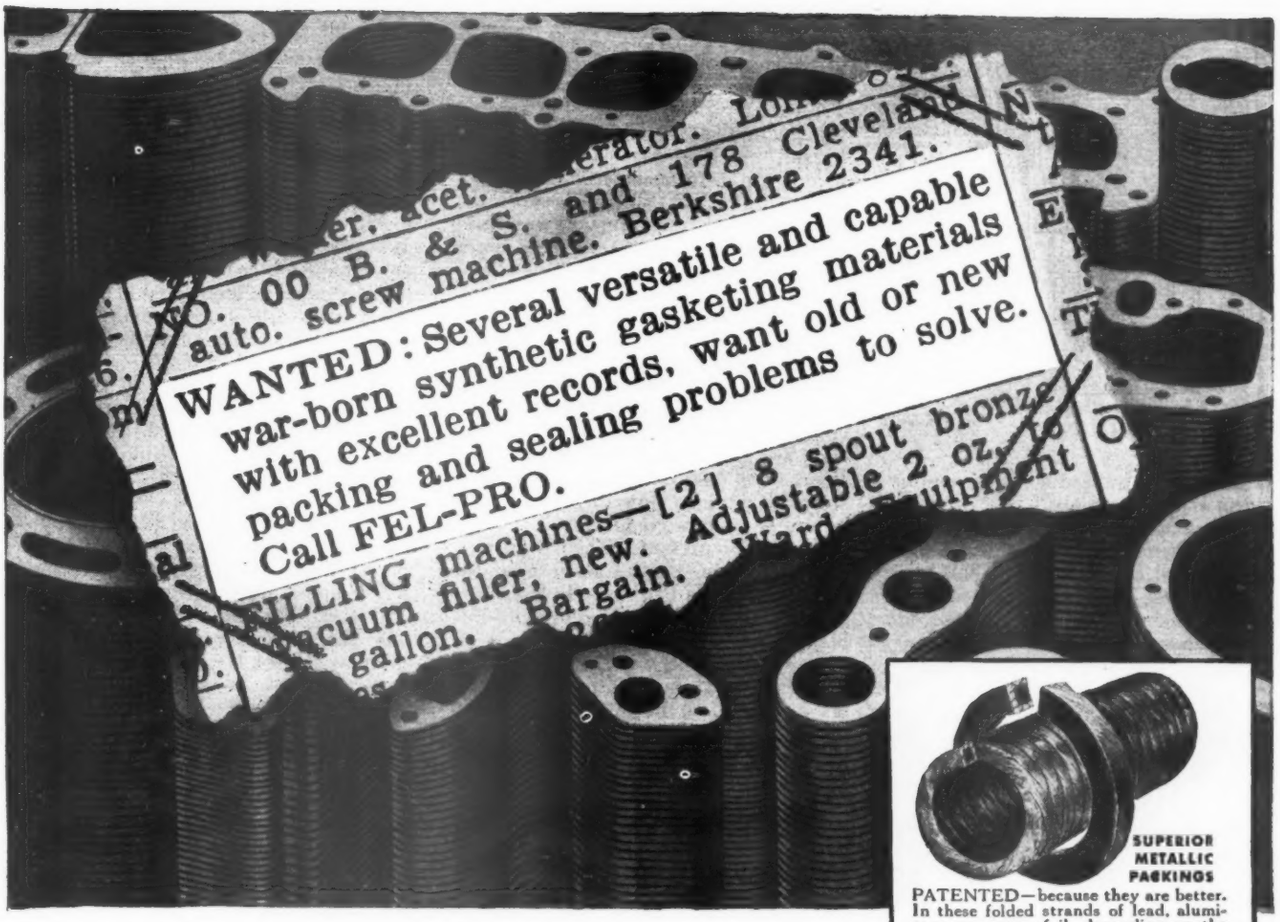
Conductivity type. Fig. 50 shows the manometer or transmitter of another electrically operated flow meter, which requires only the mercury and an electrical resistance unit for the measurement of pressure differential at a primary element.

The mercury and electrical resistance unit tubes, connected together by tubing, are situated within the high and low pressure legs of the manometer and are sealed in oil. The high pressure tap connects to the mercury chamber of the manometer.

The electrical resistance unit is made up of a series of fixed resistances connected to rods of varying lengths and in spiral form. As the differential causes a movement of the mercury into the unit chamber, contacting the rods, the increasing height of mercury decreases the resistance in the circuit thereby increasing the current flow. The recorder or indicator are a simplified form of the wattmeter, and the integrator is the usual watthour meter connected into the alternating current circuit to actuate the complete system.

It is very important with this type of meter that the manometer be entirely free from leaks particularly on steam or water measurement, for a small oil leak neglected over a period of time will eventually permit the seal oil to escape and the water level to build up, until it reaches and short circuits the electrical element.

An outstanding advantage of the electrical type meter is the remote feature, for the indicator, recorder, or integrator may be situated a considerable distance from the transmitter. This eliminates lengthy meter lines or tubing with the attendant problems of slope, air pockets, leaks, etc., and is generally conducive to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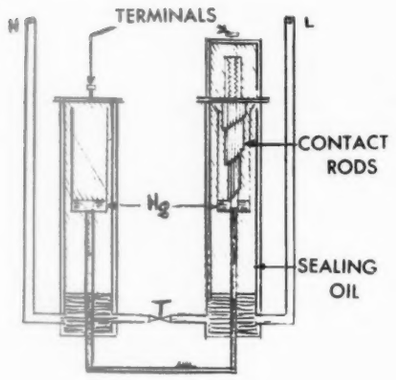


FIG. 50

the modern centralized control panel or control room operation.

Some manufacturers of the electric type flow meters have available electrically operated low pressure or bell type meters. These flow measuring devices are, in principle, the same as those described under mechanical bell type meters and equipped for electrical operation.

● **The electronic flow meter.** A flow meter utilizing an electronic amplifier in the bridge circuit recently has been added to one manufacturer's line of instrument equipment.

The transmitter (see Fig. 51) consists of a transformer with its primary winding wound around a non-magnetic tube and the double secondary concentrically wound over the primary. A soft iron core in the non-magnetic tube is positioned by the motion of the manometer bellows. The core position regulates the induced voltage in the secondary of the transformer, which is connected to a slide wire in the instrument forming a bridge circuit. Differential voltage between the slide wire and transformer is amplified sufficiently to operate a reversable motor in the direction required for repositioning the slide wire to rebalance the circuit. This movement of the slide wire, through mechanical linkage, indicates or records the fluid flow rate. The motor circuit starts operation with a 0.0005 in. movement of the transformer core, providing high sensitivity. Calculating systems are also available in this type instrument to totalize, divide, multiply, or subtract various flow quantities and groups of the flow quantities.

Fig. 52 represents schematically a typical totalizing application of the above equipment at the Paulsboro Refinery.

A, B, and C in the figure represents the boiler meters on the control panels of the respective boilers in the No. 3 boiler house. The total steam output of the boilers is totalized on the flow indicator (D) in No. 3 boiler house and then transmitted to another flow indicator (E) in No. 1 boiler house.

The total steam output of the No. 1 house boilers are also totalized on a flow indicator (K) in the boiler house and transmitted to flow indicator (L) in No. 3 boiler house.

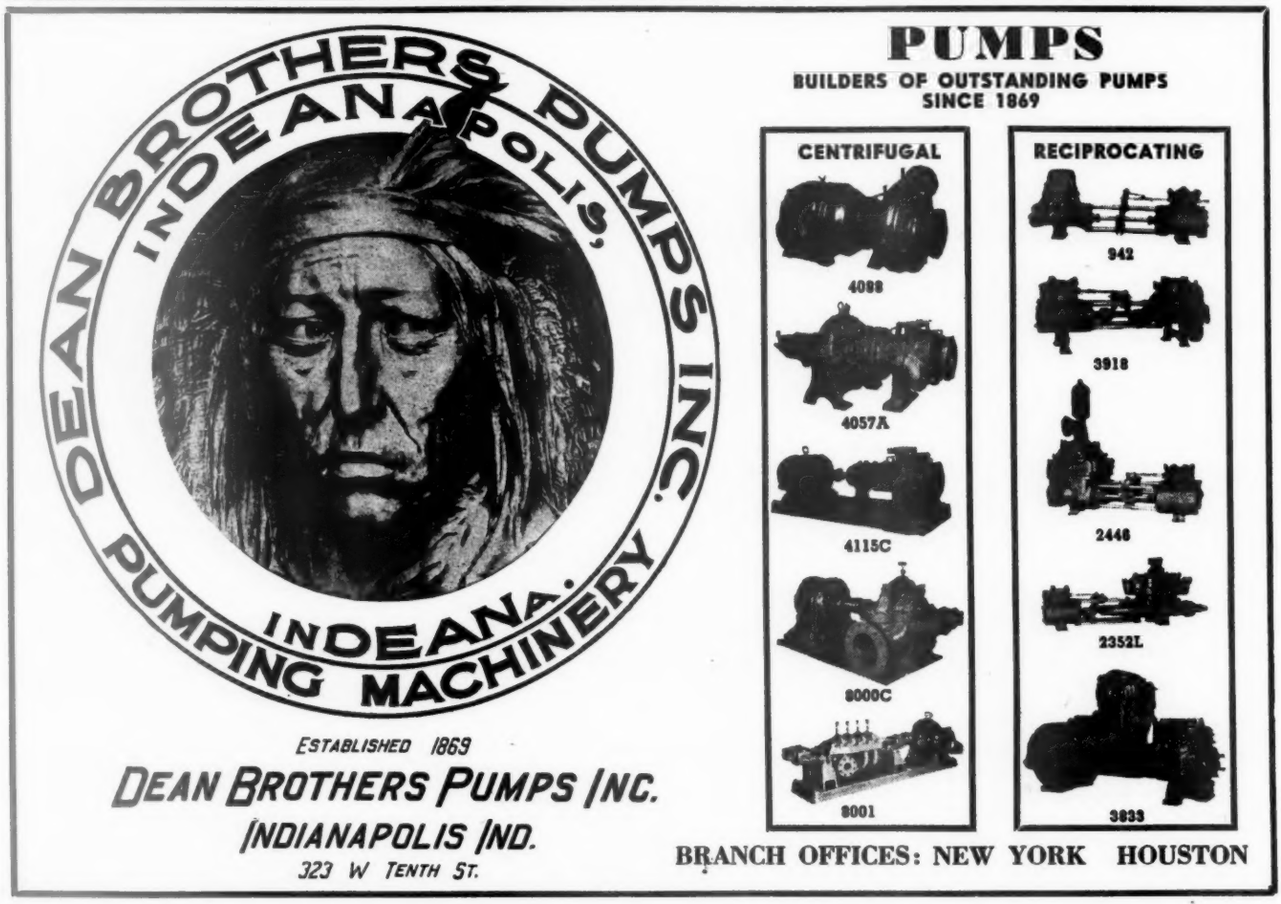
The total steam output of boiler houses No. 1 and No. 3 is transmitted from the indicators (E and K) to a recording integrating meter R. An indication of this total is transmitted from this recorder to an indicator (M). Thus the individual boiler house totals and the total of both houses are made available to the operating force.

● **Area meters.** *Rotameter type.* The most simple of the area type meters comprises a metal float enclosed in a tapered pyrex glass tube supported by suitable fittings for vertical installation in a pipe. (See Fig. 53-A.)

Flow measuring devices of this type are termed rotameters, due to the rotating of the float when a fluid is in motion. They have high reproducible accuracy, and because of the basically long scale, a high reading accuracy.

The pyrex glass tube is resistant to most all fluids, the exceptions being hot caustic and hydrofluoric acid. Pressure and temperature ranges are limited in the standard design, however, an extension arrangement may be used either above or below a metal tube to overcome such conditions. These extensions are in the general form of a high pressure gage or sight glass, in which an indicator attached to the float gives the flow reading. The flow rate scale is either etched in the glass or mounted alongside the tube. In the latter case a capacity change is easily accomplished by replacing the scale and the tube float.

The tube is self cleaning as the tur-



bulence created by the flow and by the floats rotating motion have a tendency to carry off sediment. On some installations, where the measured flow leaves a deposit, the glass may be easily cleaned by removing the top and bottom plugs and washing the glass with a tube brush and cleaning fluid.

Pressure loss created by the rotor or float does not increase with an increase of flow but remains constant regardless of the position of the float and total pressure loss through the tube of small fractions of an inch of water can be assured by the proper selection of tube and rotor sizes.

Due to the inherent glass fragility, great care must be taken when the rotameter is installed. Piping strains must be eliminated and location be such that there is little or no water hammer or thermal shock.

There are many adaptations of the rotameter for hot and cold fluid measurement and for measuring high capacities and velocities by the so called "bypass" method.

Electric type rotameters are available using the conventional inductance coil and core as in the electric flow meters previously described. The indicating, recording controlling and integrating types of instruments for flow measurement, by this method may, therefore, be classified as another form of electric flow meter.

Pneumatic type controllers and transmission systems are obtainable and are standard equipment items in some manufacturers' catalogs. Gravitometers in rotameter form indicate gravity readings from a continuously flowing sample of fluid through a rotameter tube, and it may be said that rotameters in one of the numerous forms may be applied to any desired flow measurement application.

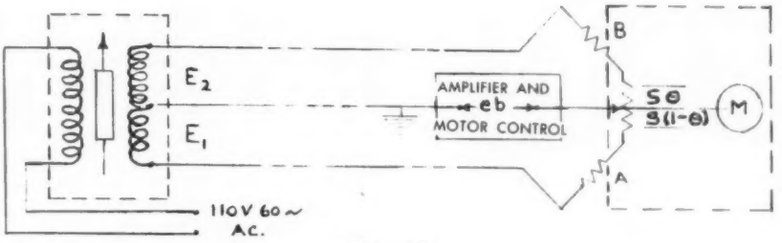


FIG. 51

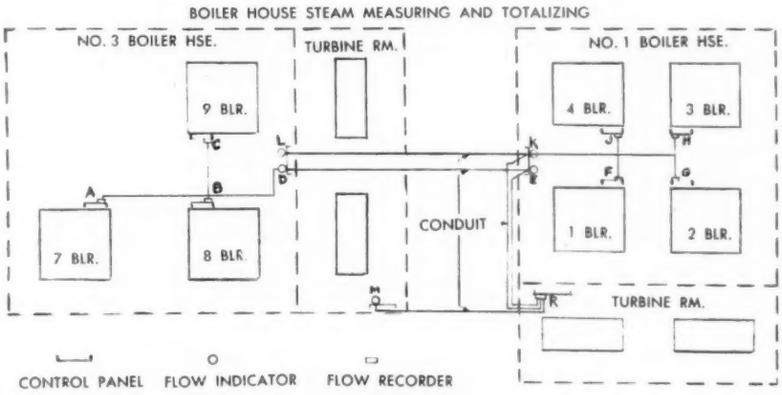


FIG. 52

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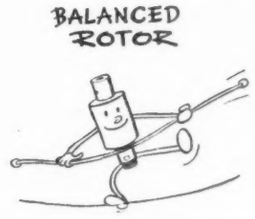

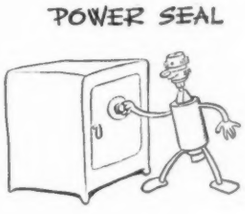

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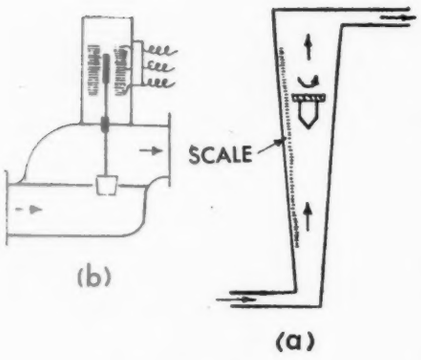

FIG. 53

Piston type. Another area meter uses the electrical inductance bridge principle for transmission. (See Fig. 53-B). The body casting, inserted in the pipe line of the fluid to be measured, is designed somewhat like the body of a regulating valve. The flow enters the body under a piston to which is attached the core or armature of the solenoid coil, and passes through the orifice to the opposite side of the body. The piston forms the top of a rectangular orifice, which is varied in size as the piston moves upward or downward. Pressure on the piston and the low pressure side is equalized by a built-in by-pass, thus equalizing the pressure also on the downstream side. A motion of the piston opens the variable orifice sufficiently to hold the pressure differential constant on both sides of the orifice. Flow graduations are equally spaced, for only one dimension of the orifice is varied. The piston range is changed by increasing or decreasing the weight on the piston.

The flow rate is recorded or indicated as previously described in the section under "Electrical Meters—Inductance Bridge Type."

Twenty pipe diameters of straight pipe ahead of the meter body is required for proper installation and a by-pass around it is desirable to permit removal if necessary.

This type of meter is exceptionally desirable where the fluid to be measured is dirty or has a high viscosity, such as heavy oil, tar, or fluids difficult to measure with the conventional differential pressure meter where seals and heating mediums are required.

● **Integrators.** The flow meters already described are available in both the indicating and recording types.

It is often desirable to integrate the total flow over a given period of time. For short time intervals, where fluctuating conditions do not exist, the chart will give the desired information; however, when measuring utility services such as station efficiency in power stations, or for accounting purposes such as on steam, gas, water, or air distribution, there are 2 methods of totalizing available.

The planimeter method mechanically averages the flow on either square root or uniformly spaced charts. This method is a manual operation and can be done only after the chart has been removed from the meter.

In order to eliminate the inconvenience of the planimeter method as above, instruments are available that incorporate mechanical or electrical integration, making it possible to obtain the flow from a totalizing counter at any time.

In selecting an integrating device, the simplicity and dependability of the mechanism should be carefully considered, for the maintenance or the more complicated types may prove costly.

● **Static pressure pen.** On many gas, air, or steam flow applications where the pressure is variable it is necessary to have a record of the static pressure in order accurately to measure the rates of flow. As a gaseous fluid is compressible, the pressure has considerable effect on the flow coefficient. Some mechanical types of meters are designed so that a static pressure pen may be installed should conditions warrant.

A pressure compensating integrator is available from many manufacturers. This mechanism records and compensates for pressure changes at the time of each unit integration.

● **Square root compensation.** As the flow varies as the square root of the differential pressure across the primary element, the conventional flow meter chart becomes, of necessity, a logarithmic function. As the square root chart is more difficult to read at the lower range, it was considered advisable by some manufacturers to make use of a uniformly divided chart. There are various methods in use to accomplish this purpose, i.e., the introduction of a cam (see Fig. 46-C) to extract the square root mechanically in the recorder case, or by using a parabolic type range tube as shown in Fig. 46-E. The formed bell, as shown in Fig. 46-F, is another method of accomplishing the same result.

Although the square root compensating methods as described above permit the use of a uniformly spaced chart, it must also be realized that, depending upon the method employed, a more critical adjustment of zero mercury level is required. Where a critical mercury level condition exists, a slight loss of mercury may easily result in an error of considerable magnitude in flow readings. An error caused by a mercury loss may be undetected until such a time as the meter is checked for zero.

● **Ratio flow control.** On processes in which the flow of two fluids bears a definite ratio to each other, accurate proportioning is difficult without automatic ratio control. With this method, the primary or "wild" stream is directly controlled by action of the process. The controlled, or secondary stream rate is maintained in proper ratio in the primary fluid.

In principle, the flow ratio controller is the conventional flow meter with double sets of differential chambers. One of these sets is connected to an orifice in the "primary" fluid pipe line and the other set to an orifice in the "secondary" line. These orifices are computed for the required ratio between the 2 measured fluids and minor changes in ratio are accomplished within the instrument case.

Control linkage between the 2 flow mechanisms is so arranged that the motion of the primary flow mechanism oprates the setting device of the control mechanism in a position to maintain the required ratio of rates. The flow in the primary fluid line may vary, but the secondary fluid rate will be varied also to correspond to the desired rate requirements.

At the Paulsboro Refinery, one ratio control installation is shown schemati-

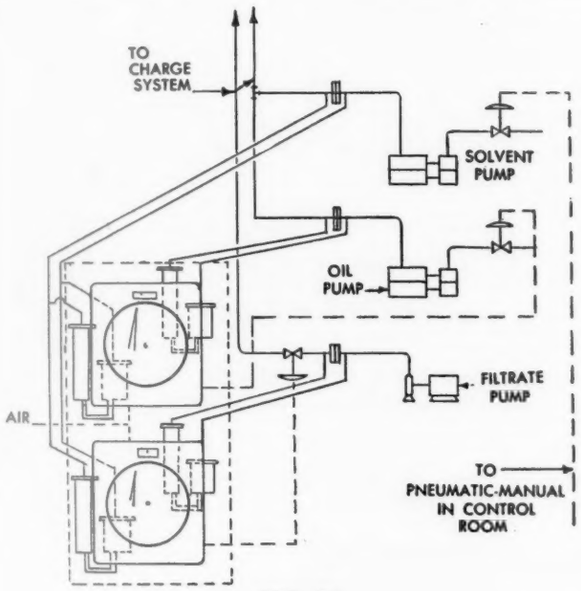

FIG. 54

FIG. 55

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Fig. 2125 Bronze Gate

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Fig. 16 "Renewo" Globe

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Fig. 1430 Iron Body Gate

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Fig. 1834 "Alvor" Constant Level Oil Control

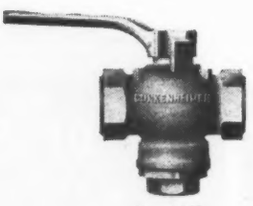
Fig. 1571 Air Cock 150 Lb. Pressure

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cally in Fig. 54. Here it is required to ratio 2 secondary streams to 1 primary. Although this could be accomplished by 1 ratio instrument, flow and control conditions on the secondary stream No. 2 were such that an individual ratio controller was selected for the application. This method assures greater flexibility with accurate control.

● **Volumetric type meters.** The volumetric meter is fundamentally different from the differential type meter in that the actual volume of fluid passing through is measured in the meter and totaled on a simple counter device. There are available numerous types of volumetric meters, such as piston type, rotating disk type, rotary sliding vane type, oscillating piston type, etc. (See Fig. 55). Although these meters make up a large and important group, the space available in this article does not permit a detailed discussion of their design and specific characteristics.

The volumetric type meter has gained widespread use as a total flow measuring device on operations such as gasoline loading racks where a high degree of accuracy is essential. The guaranteed accuracy of the higher quality meter of this type will vary from 0.2 to 0.3 per cent when used within design limits.

They are portable, compact, and easily installed.

The initial cost of the large sizes is much higher than an ordinary orifice meter, and the repairs likewise are expensive. They are suitable for clean fluids only, for any dirt or abrasive materials will damage or eventually plug the meter or make it inaccurate.

● **Flow control.** In analyzing flow control problems, it is obvious that the use of a simple pneumatic "on-off" controller is ample for many applications in industry; however, in the control of modern refinery process units where a definite sequence of instruments is closely related to the continuous flow of products, any disturbances that may cause a cycling action of the control valve are highly undesirable. For this reason "on-off" control has definite limitations for continuous process applications.

Proportional control when applied to flow problems of this nature will give fairly satisfactory results on applications where the process lags or load changes are not too unfavorable. This type of control may be adjusted for a wide throttling action, which will result in small valve reaction thereby eliminating the possibility of cycling.

When conditions are such that the demand changes are large and unfavorable process lags exist, the proportional reset control is of necessity best suited to the application. Using this type of instrument will insure precision control under a wide range of unfavorable process variables.

(This is the fourth of a series of articles by Mr. Krieg. The next will appear in an early issue.)

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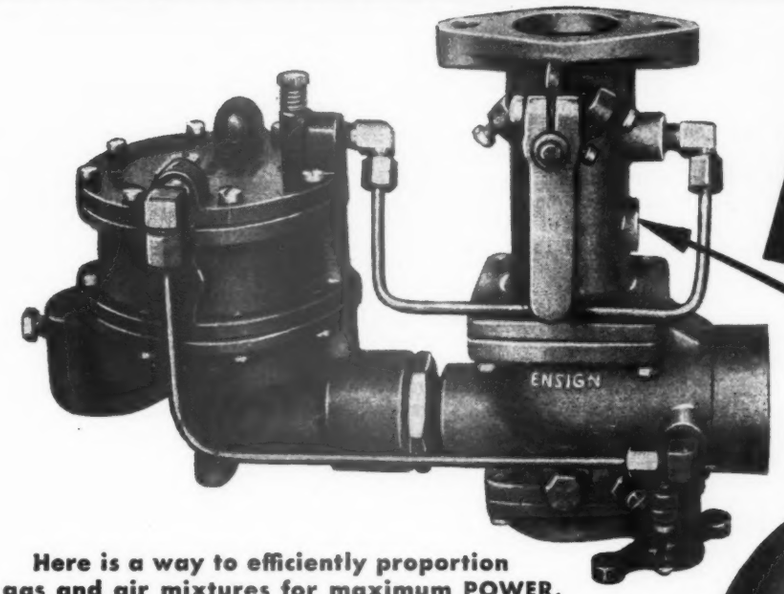

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WATER ANALYSIS IN CYCLING FIELDS

AN extensive program of analysis of waters from cycling wells recently completed by the Corrosion Research Project Committee of the Natural Gasoline Association of America has yielded some significant information on the physical and chemical differences of corrosive and non-corrosive fields. Although not as conclusive as first anticipated, the data indicate that appreciable quantities of iron and organic acids in well waters do not necessarily indicate a high rate of corrosion nor even that corrosion is present.

The work is part of the broad cycling well corrosion studies of the NGAA Corrosion Committee of which T. S. Bacon, Lone Star Producing Company, Dallas, Texas, is chairman. Operating as a co-operatively financed project, the primary object of the committee is to determine the cause of corrosion in gas condensate fields. This corrosion has been observed in tubing strings at depths up to 10,000 ft. and has been serious throughout tubing strings, wellhead equipment, and flow lines from wells to cycling plants. Several theories have been suggested on the causes of this corrosion. One theory is that carbonic acid formed from reaction of the carbon dioxide content of the gas with the liquid water condensed from the gas might attack the steel equipment. Another theory was based on the fact that appreciable concentrations of the lighter fatty acids, such as acetic and propionic acids, were found in water samples obtained from corroded wells. It also seemed possible that the joint action of the carbonic acid and of the organic acids might be responsible for this serious corrosive attack.

In order to obtain factual information on the presence of the above acids, and on other chemical constituents of the waters produced from corroded wells, the NGAA instituted a sampling program of broad scope. Water samples were obtained from wells and fields of known corrosiveness and were carefully analyzed under the supervision of Prof. W. A. Cunningham, head of the Department of Chemical Engineering, at the University of Texas. As the committee realized that samples from corroded wells would give one side of the picture only, it arranged to have an approximately equal number of samples collected from wells that showed no corrosion. These samples from non-corroded wells were analyzed in the same way, following the same techniques, so that direct comparisons could be made between the chemical composition of water samples from corrosive wells and from non-corrosive wells.

Duplicate samples were obtained from each well or field so that some indication of variation in chemical composition could be made. Samples were obtained from 14 corrosive fields, 10 non-corrosive fields, and 12 fields on which available operating information was insufficient to determine whether or not a corrosive condition existed. The maximum values, minimum values, and average values of the data obtained are shown in the accompanying table. It is interesting to note that the carbon dioxide content of the gas from the corrosive fields is definitely higher than that of the gas from the non-corrosive fields; however, it seems unlikely that this difference in carbon dioxide content as observed is sufficient in itself to explain the extreme differences in rates of corrosive attack. It is also interesting to observe that organic acid concentrations are very slightly higher in the corrosive fields than in the non-corrosive fields. It appears from this information that the presence of organic acids in the wellhead water samples is not in itself an indication of the likelihood of serious corrosive attack.

Salt water is a well known corrosive agent in the presence of oxygen. Gas wells do not contain oxygen and therefore the corrosiveness of the salt water is nominal. The amount of salt water in the wellhead samples is indicated by the chloride content. It is noted from the data that many corrosive fields show very appreciable concentrations of salt water whereas many other corrosive fields show practically no salt in the wellhead water samples. The non-corrosive fields also range in salt content from zero to extremely high concentrations as judged by the chloride content of the water samples.

The dissolved iron contents of the water samples of the corrosive fields were definitely higher than the dissolved iron contents of the water samples from the non-corrosive fields; however, some non-corrosive fields showed higher iron contents than some of the definitely corrosive fields. Therefore, it appears that iron content alone is not a satisfactory indication of the amount of corrosion that may be anticipated in any particular well or field.

The available data in their present form fail to show any significant chemical differences in the composition of water samples from corrosive fields as compared with water samples from non-corrosive fields. These data indicate higher average pressures and higher average temperatures in the corrosive fields than in the non-corrosive fields. It is well known that acid attack of metals increased rapidly with increase in temperature and also that the effectiveness of inhibitors in preventing acid attack of metals decreases rapidly with rise in temperatures. Other work on this subject of high pressure corrosion sponsored by the NGAA, and under the supervision of Dr. Norman Hackerman of the University of Texas, has indicated the likelihood that the corrosive attack is an acid type of attack that is partly inhibited by some naturally occurring inhibitor in the corrosive wells and is substantially completely inhibited by the same naturally occurring inhibitor in non-corrosive wells.

The NGAA Group has not been able to draw any final conclusions from the available data to date; however, the data indicate the likelihood of acid attack of iron equipment in all gas wells. Prevention of this acid attack in the non-corrosive wells may be assumed to be due to the presence of a naturally occurring inhibitor. The NGAA Group is attempting to pursue the matter further so that this theory may either be confirmed or abandoned, and so that some reliable method of estimating the likelihood of corrosive attack in new wells and in new fields may be found. ★★★

N. G. A. A. Water Survey—Summary

	Corrosive fields			Non-corrosive fields		
	Maximum	Minimum	Average	Maximum	Minimum	Average
Depth, ft.	13,200	4,050	8,077	7,200	2,197	4,840
Reservoir temp., °F.	250	157	207	190	76	142
Reservoir pressure, lb. per sq. in.	5,000	1,330	3,243	3,200	400	1,619
Wellhead temp., °F.	170	100	134	130	72	95
Wellhead pressure, lb. per sq. in.	4,000	1,110	2,454	2,640	250	1,198
Production rate, MM. cu. ft. per day	30	2.5	9.7	10	0.7	4.3
Distillate content, bbl. per MM. cu. ft.	70	2.5	27.8	26	0	8.2
Water content, bbl. per MM. cu. ft.	3.7	0.4	1.17	34	0	6.6
CO_2, vol. per cent	2.0	0.6	0.87	0.7	0	0.35
H_2S, grains per 100 cu. ft.	0.08	0.0	0.001	0.2	0	0.05
pH (at atmos. press.)	6.5	4.5	5.4	7.2	4.1	5.8
Phenol. alkalinity, p.p.m. $CaCO_3$	0	0	0	0	0	0
M. O. alkalinity, p.p.m. $CaCO_3$	448	20	148	692	8	121
Total solids, p.p.m.	74,400	242	11,600	186,400	152	36,000
Cl, p.p.m.	39,200	0	5,780	95,500	0	18,100
SO_4, p.p.m.	104	0	21.0	70	8.5	29.9
Fe_2O_3, p.p.m.	1,280	160	439	441	57	185
Organic acids, p.p.m., C_2H_3COOH	812	49	222	405	0	156

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(1) *Water filtration*

% Proportioners, Inc., %, 28 Codding Street, Providence, Rhode Island, well-known manufacturers of chemical feeders for water purification and sterilization and proportioning equipment for treating, blending, diluting, and sampling in industrial processing, have announced a new, hand-operated water filtration unit.

This Hand Pur-O-Pumper is a ruggedly constructed, easily portable, hand-operated pump, diatomaceous earth feeder and filter for use on construction jobs or wherever a lightweight filtering unit is required for the delivery of clear water. This unit is capable of delivering 2 gal. of filtered water per min. and weighs approximately 55 lb.

Constructed of rust and corrosion-resistant materials, the Hand Pur-O-Pumper has two parts: (1) the pumping and treating unit, and (2) the filter section.

The pumping unit consists of a self-priming, synthetic rubber vaned impeller, rotary displacement pump made of bronze with the impeller mounted directly on the extended crank shaft. The pump is mounted on a tripod stand.

The filter unit is a stainless steel tank 5 in. in diam. equipped with pressure gauge, precoat feeder and connections. The tank contains a cylindrical aluminum oxide filter stone mounted directly on a cast filter cover. It is on this stone that the diatomaceous earth is deposited. The tank itself has a conical bottom with a foot valve to facilitate the discharge of sludge when backwashing.

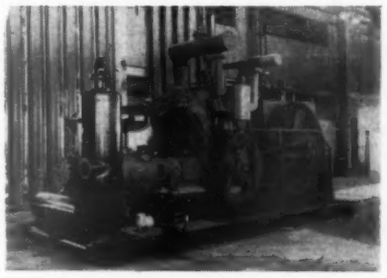
The water from the filter unit is collected in a Lyster bag or other container and purified by the addition of an ampule of calcium hypochlorite.

(2) *Compressor units*

The compressor unit shown was developed by J. B. Beaird Company, Shreveport, for use in operations such as gas lift, repressuring, flare gas collection, field gas collection for main line gas stations, and others. Operating pressures may be varied over a wide pressure range by varying compressor cylinder sizes.

The compressor unit consists of an Ingersoll-Rand compressor mounted on a large structural steel and concrete base, gas scrubbers, intake and discharge manifolds, fan-type engine-driven radiator (eliminating the necessity for a cooling tower and providing efficient closed jacket water and lubricating oil cooling systems), automatic water temperature control, speed and pressure regulators, and pressure operated shut-down control.

As this unit is completely assembled at the plant, the only work necessary to put it into operation is to connect to the inlet scrubber, discharge manifold, and fuel gas supply. Due to complete automatic controls, the attention of an operator is required for only a few minutes each day.



In event the unit is no longer required at a certain location, it can easily be moved to another without loss of buildings, permanent pipe installations, or foundation. The foundation is an integral part of the unit.

(3) *Fuel loss calculator*

A slide rule type of calculator of particular interest to boiler room operators is being offered by the Hays Corporation, Michigan City, Indiana, manufacturers of combustion instruments and control.

The calculator is used after the per cent of CO_2 in the flue gas, the temperature of the flue gas, and the room temperature have been determined. The calculator is based on several fuels of different analyses and a wide range of flue gas temperatures making it practical for use in the vast majority of boiler rooms in the country.

The figures on the calculator reveal the per cent of total heat loss in the flue gas. Instructions accompanying the calculator show how heat loss can be converted into fuel loss. The figures on the various scales are various calculations by the Hays engineering department and are dependably accurate.

The calculator is being distributed to all interested users without cost.

(4) *Emulsion breaker*

Honan-Crane Corporation, a subsidiary of Houdaille-Hershey Corporation, has made arrangements for the exclusive sale and distribution of Visco 77, a lubricating oil-water emulsion breaker.

Visco 77 is a liquid chemical additive that, when added to the most stubborn water emulsions in the amount of 1/10 of 1 per cent (1 gal. of Visco 77 to 1000 gal. of lubricating oil) and the oil maintained "at rest" at a temperature of from 180-185°F., will break the emulsion and all water will settle out in from 24 to 48 hr., according to the manufacturer.

Visco 77 has been in use for several years by some of the major industries on viscous circulating system oils, as well as heavy EP oils, and is equally satisfactory on both types of oils, or on any oil regardless of viscosity, it is asserted.

Visco 77 is non-corrosive and harmless to any lubricating oil, and can be used with safety on any major circulating system where difficulty is experienced in removing water from the lubricating oil.

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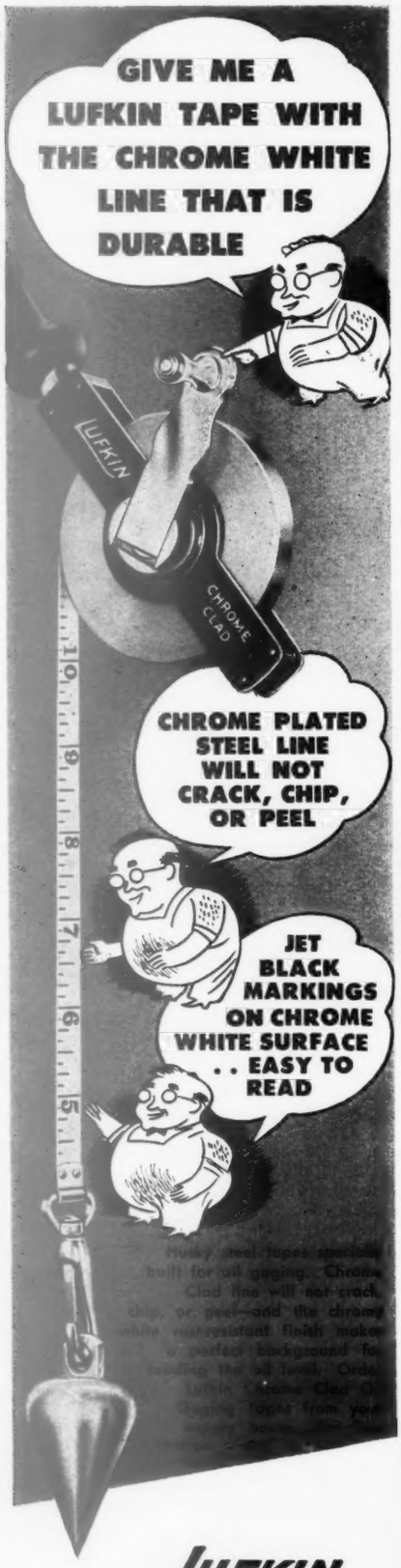
Advancements in petroleum and plant equipment are being made rapidly. Keep abreast by making full use of *The Petroleum Engineer's* enlarged New Equipment Section.

All items are numbered. A business reply card requiring no postage if mailed within the United States is provided. Check or encircle the number on the card that corresponds with the product or products in which you are interested and drop it in the mail. Literature and prices will be sent promptly on receipt of card.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CHROME PLATED STEEL LINE WILL NOT CRACK, CHIP, OR PEEL
JET BLACK MARKINGS ON CHROME WHITE SURFACE .. EASY TO READ

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THE LUFKIN RULE COMPANY

SAGINAW, MICHIGAN

New York City, N. Y.

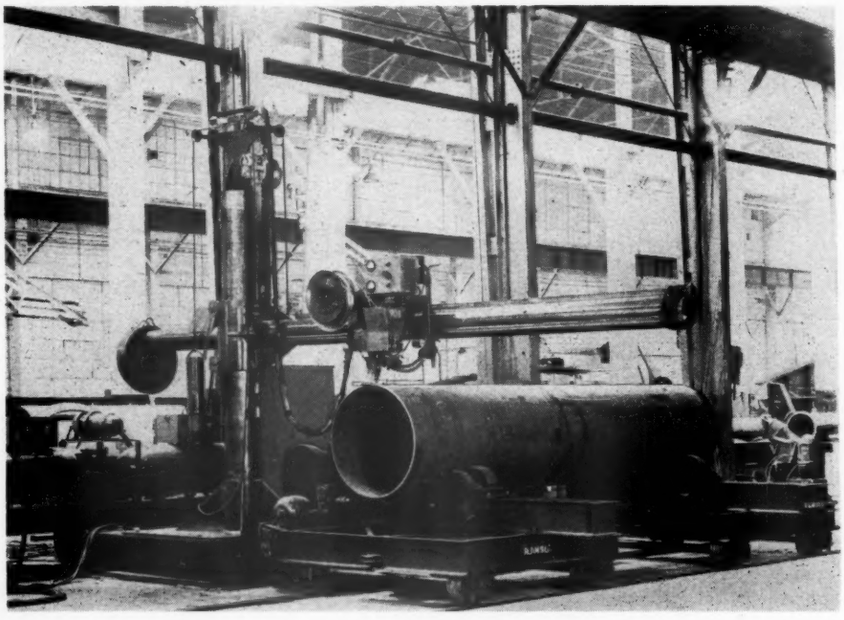
(5) *Turning rolls*

Self-propelled turning rolls mounted on tracks, with the automatic head in a fixed position, for stepped-up automatic welding production on tanks and cylindrical objects of various lengths and diameters are used by the Struthers Wells Corporation, in Warren, Pennsylvania. On circular welds, the weldment is set on the turning rolls and rotated, for longitudinal welds, the work is driven along the track, both at the desired welding speed. The work is thus positioned under the automatic head for all welding operations.

Self-propelled turning rolls consist of two parts, the electric power-driven turning rolls and the idler rolls without power, each mounted on separate carriages. The power drive serves a dual purpose. It rotates weldments for circular welds, and by shifting a clutch, the power is transferred to drive the work forward or reverse on the tracks for welding logitudinal seams. The individual rollers are equipped with tires of industrial truck type rubber to prevent bumping when logitudinal welds pass over the rollers.

The weight capacity of these new Ransome self-propelled turning rolls is 25 tons. The distance between the rollers is adjustable to accommodate diameters of work from 2 ft. to 14 ft.

Ransome Machinery Company, or Dunellen, New Jersey, a subsidiary of Worthington Pump and Machinery Corporation, designed this new Size No. 1 Self-Propelled Turning Roll to provide the most economical manner of handling the welding fabrications of tanks and all circular work for automatic welding, it is stated. It is the latest addition to Ransome's complete line of positioning and turning roll equipment for welding and work applications.

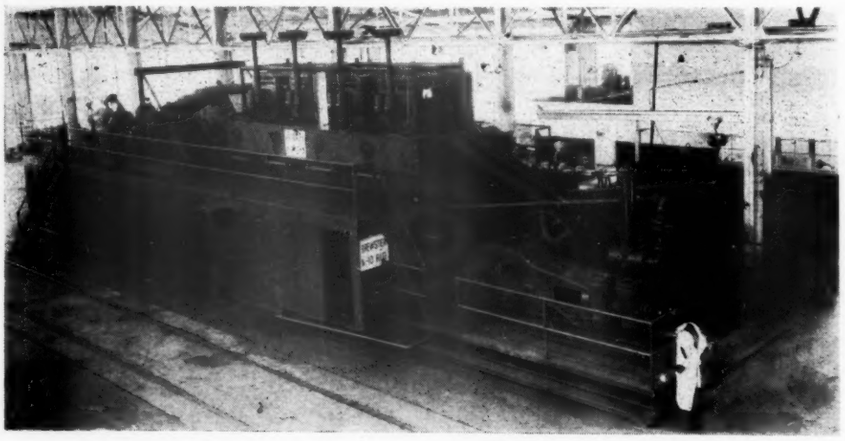


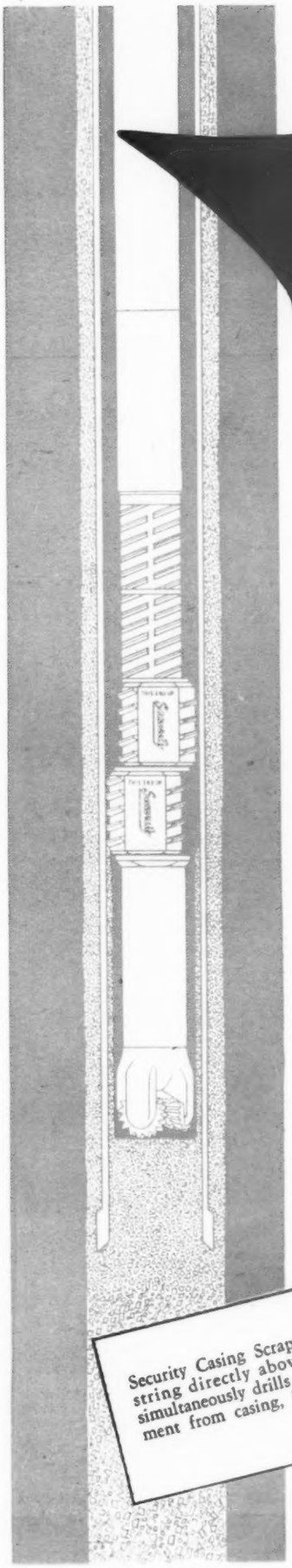
(Courtesy of Struthers Wells Corporation)

(6) *Brewster rig*

The Brewster Company, Shreveport, Louisiana, recently announced its new N-10 drilling rig. The new rig will drill to 10,000 ft. with 4½-in. drill pipe. Air controls grouped together near the driller's position give convenient and effortless control to the entire rig. Manual controls are optional.

The rig is rated at 800 hp. in any combination of motor assemblies. The hydromatic brake is standard equipment. Drum brakes are water cooled. The rig is equipped with a high and low friction clutch. There are 8 speeds on the clutch. The rotary is a 22-in. oilbath machine built into the substructure floor. The substructure is built as a part of the entire assembly and can be disassembled in sections for convenient hauling.





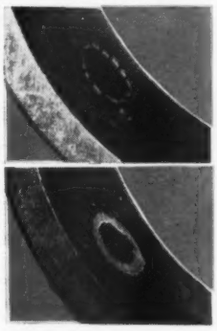
Here's what the

SECURITY CASING SCRAPER

does for your well completion program

ANY OBSTRUCTION within the casing walls can tear packers, spoil swabs, prematurely set cement retainers, prevent equipment from operating properly, cause needless delays, and run up well completion costs. All of these troubles can be easily avoided by the use of a Security Casing Scraper. The unique shearing action of the tool thoroughly removes all undesirable obstructions and foreign matter from within the casing walls, thus assuring at all times free downward passage of tools and equipment. It's a simple matter to clean your casing before the well is completed by running a Security Casing Scraper, thus assuring clean casing surfaces for immediate or future production operations. No service man is required.

AND HERE'S WHY THE SECURITY CASING SCRAPER LEADS THE FIELD!

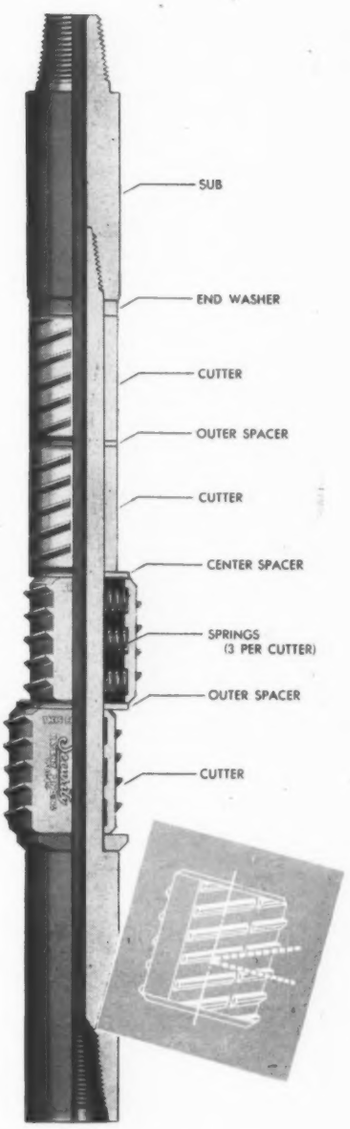


Distinct advantages of the Security Casing Scraper are readily apparent. During rotation, the helical cutting teeth *shear* all protrusions instead of exerting a scraping or crushing action. This positive shearing action is demonstrated by the clean removal of internal burrs left by gun perforating. Note the gun perforations are not burred over but are smoothly removed, retaining full unrestricted opening.

The Cutters are expanded to the full inside diameter of the casing by positive spring pressure and contact approximately 360° of the casing circumference at all times. The multiple spiral teeth cannot pass obstructions *without indicating their presence to the operator.* Every point in the casing is contacted by the cutting teeth which remove each burr and every particle of incrusted cement or other undesirable material by a steady, powerful shearing action. If you like figures, note this: The 7" casing scraper has 24 individual shearing teeth which form a total of 98 linear inches of cutting surface. The teeth act upon an obstruction approximately 800 times under average operating conditions!

FEW PARTS—SIMPLE CONSTRUCTION ASSURE ECONOMY

Four reversible cutters, having rectangular openings through the center, are slidably mounted on a square mandrel. Each cutter is firmly expanded against the casing walls by 3 strong coil springs and is separated by spacers which permit ready circulation but prevent enfrance of debris within the spring recesses. The multiple cutter teeth contacting the casing throughout their length make certain that every inch of casing is thoroughly cleaned. Cutters are reversible, providing new teeth, when required. Learn ALL THE FACTS and get an improved cleaning job. Our bulletin CS 463 describes this tool in detail. Write for it today!



As mandrel rotates, helical teeth produce a shearing action, quickly and cleanly cutting away all foreign materials and undesirable protrusions.

Security Casing Scraper placed in drill string directly above "Cleanout Bit" simultaneously drills out and scrapes cement from casing, leaving walls clean.

SECURITY ENGINEERING CO., INC.

ONE OF THE DRESSER INDUSTRIES

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Branches in All Principal Oil Fields

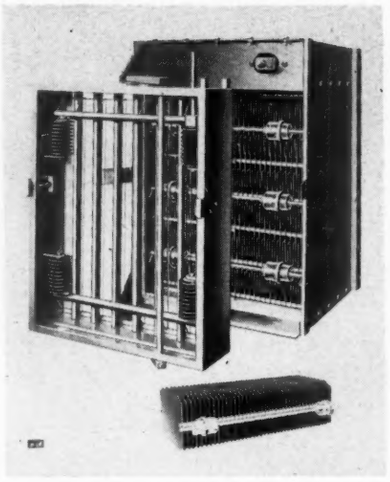
(7) *Electro-cell*

The Electro-Cell, a unit type electronic air filter with removable collector plate assemblies, is one of the latest type now being manufactured by the American Air Filter Company, Inc., Louisville, Kentucky.

The positive and negative collector plates are assembled on cross rods to form horizontal groups, which are easy to handle and may be readily removed from the filter casing. This makes possible a number of innovations in construction that simplify installation, improve performance, and assure better maintenance.

Sliding into the filter casing in much the same manner as a desk drawer, plate assemblies can be removed for cleaning and reoiling at convenient water and sewer connections. By keeping a spare set of plates sufficient for one section for use as a replacement, the length of time the filter is out of service is reduced to a minimum and the dirty collector plate assemblies can be cleaned at a time that is most convenient for maintenance personnel. An automatic washing device has been developed permitting collector plate assemblies to be washed in place for installations where manual washing is not feasible.

Standard sections of the Electro-Cell are 2 and 3 ft. in width with a capacity of 1000 cu. ft. per min. per unit and range from this minimum to as many sections as are needed for the particular installation. The construction of the filter is such that it eliminates the duplication of top and bottom sections of box-like units when assembled one upon another. This is accomplished by the manufacture of the filter in a variation of heights from a minimum of 27 in. to a maximum standard height of 15 ft. by 9-in. increments.



In the larger sizes of the Electro-Cell (6 ft. or higher), the ionizers are mounted on a bar hinge that swings clear of duct work or adjacent sections giving full access to collector plates. Extending the full height of the section, electrical losses are reduced to a minimum due to fewer wire ends.

(8) *Oil-well plunger*

The Gustin-Bacon Manufacturing Company announces an inexpensive plunger that will give long, efficient service even where excess sand, water, or gas is encountered. It will be called the G-B EXPAN-SEAL plunger.

The plunger consists of a steel core on which are assembled a series of oil-resisting, synthetic rubber split rings that work in connection with metal spacers so that they automatically expand to the pump barrel wall on the lifting stroke, providing a perfect seal and preventing oil slippage, and then contract and move off the cup seat on the return stroke, reducing friction and wear and allowing any sand to be washed away with the oil. This action also allows any gas trapped between the pump valves to escape, preventing gas locking of the pump.

The EXPAN-SEAL plunger works equally well in tubing pumps, insert pumps, and in common working barrels, the manufacturer states. It is available in standard A.P.I. barrel sizes and because the rings automatically expand to the barrel wall on each lifting stroke it is never necessary to recup with plus 15 or 30 thousandths oversize cups. The EXPAN-SEAL composition rings come ready to install and need not be presoaked in kerosine or oil before installation.

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For nearly every application where the load is radial you'll find an AMERICAN RADIAL ROLLER BEARING to meet your requirements. Engineered to exacting standards, precision tested, specially designed for smooth, reliable operation under tremendous loads, AMERICAN RADIAL ROLLER BEARINGS function flawlessly in the heaviest equipment built and under the most rigorous operating conditions encountered in any industry.
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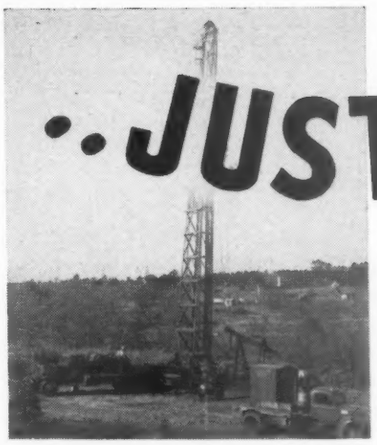
Heavy-Duty ROLLER BEARINGS

..JUST 65 MINUTES—

TO TEAR DOWN, MOVE AND RIG-UP FOR ANOTHER JOB



30 — Tearing down operation, including putting well on pump . . . 30 minutes.

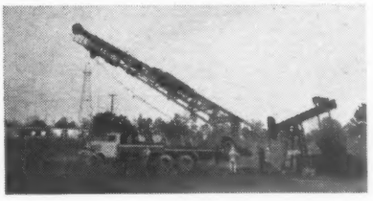
15

Unit in over-the-road position, moving ¼ mile . . . 15 minutes.

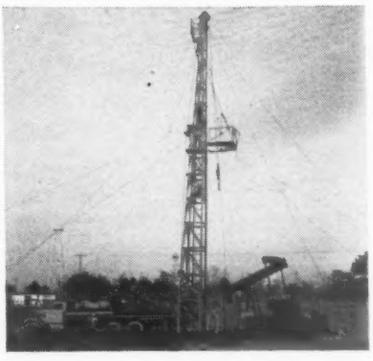
4

Spotting unit at well location . . . 4 minutes.

5



Raising Telescoping Derrick by a built-in power screw raising device (exclusive, patented Franks feature) driven by the truck engine . . . 5 minutes.



4 — Extending the upper section of the Telescoping Derrick by a small winch of 45,000 lb. ultimate capacity, also driven by the power of the truck engine . . . 4 minutes.

7 — Completion of pump disconnection and taking hold of rods with elevator . . . 7 minutes.

Franks' improved Model 5000 truck motor driven unit is an all purpose servicing unit so designed as to be adaptable to all the normal servicing operations required in maintaining the production of oil wells. It consists of a truck mounted winch with optional sandreel, spudding attachment, rotary drive attachment, provision for regular independently clutched cathead, telescoping derrick, and other optional equipment as required under varying conditions. This unit may be used as a conventional servicing winch to pull rods and tubing to 5,000 feet. It is suitable, when supplied with the necessary extras for rotary clean-out work to 4,000 feet, and may be used with standard cable tools in "tailing in" and deepening operations to 5,000 feet, and actual drilling from the grass roots down to 3,000 feet. Since the derrick is mechanically raised and lowered by the power of the truck engine and carries lines and blocks strung and guy lines attached at all times, rig-up and tear-down time is reduced to a matter of minutes.

FRANKS MODEL 5000 ALL-SERVICE UNIT PHOTOGRAPHED AND TIMED ON LOCATION

FRANKS REPRESENTATIVES:

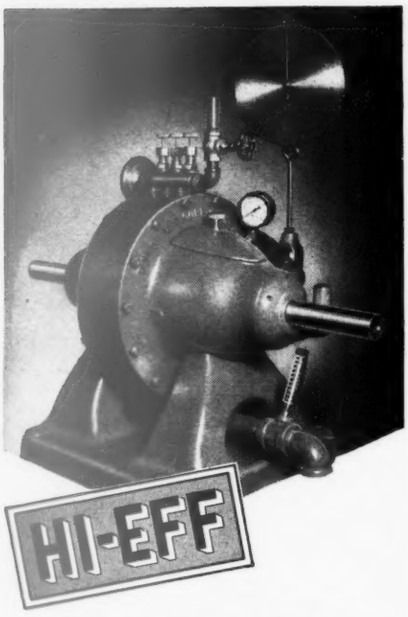
Export: A. V. Simonson, 149 Broadway, New York, N. Y.
California: Hillman-Kelley, Inc., 1000 Macy Street, Los Angeles.
Illinois Basin: Stuart E. Corry, Box 51, Fairfield, Illinois.
Texas, Louisiana, New Mexico: R. M. White, 823 Neil P. Anderson Bldg., Fort Worth, Texas.
Rocky Mountain: Industrial Power Units, Inc., Box 152, Casper, Wyo.

FRANKS EXPANDED FIELD SERVICE

In keeping with Franks' policy of servicing its equipment and as an extension for such service we have now established two additional field service points and two resident field service men.

West Texas: Odessa East Texas: Longview

In these areas call these points for Franks Field Service.



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You can depend on the performance data taken off a "HI-EFF" hydraulic dynamometer. All frictional and torque losses, except of cradle bearing, are measured on the scale, giving an accuracy approximately 99.7% perfect. This high degree of accuracy is maintained with all capacities to 6,500 H.P.—speeds to 25,000 R.P.M.

Considering the low initial cost, minimum maintenance expense and small floor space required, you can have "HI-EFF" accuracy at cost savings that will surprise you. There are 72 different capacity models available from standard patterns. Write for complete details. Taylor Manufacturing Co., 3046 West Meinecke Avenue, Milwaukee 10, Wis.

TAYLOR OF MILWAUKEE

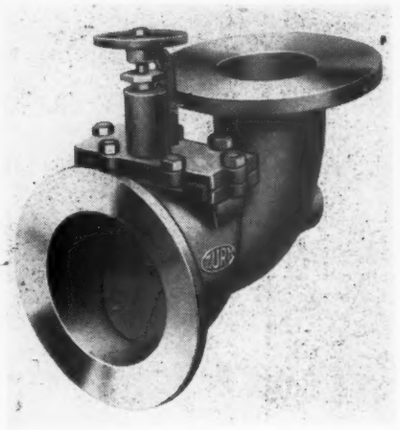
"HI-EFF" Hydraulic Dynamometers
Static Balancing Machines
Sensitive Drilling Machines

(9) *Check valve*

A discharge check valve has been designed to give positive protection against the back-surge of discharge lines carrying steam, sludge, waste water, and other waste liquids in gravity flow installations.

In order to assure non-fouling of the valve, hese units have a swing check flap suspended from a full floating pin fulcrum to give positive full surface between ground face of flap and flap seat.

The knob in the center of the top surface of the swing check flap contacts the valve body roof at only one point when the swing check flap is wide open. This prevents the swing check flap from touching the sides of the valve body and assures free operation of the swing check flap. Location of swing check flap in relation to interior of valve body



provides ample protection against sediment blocking of the valve. Swing check flap suspended from cover can easily be removed and replaced.

Discharge check valves may be operated with or without a manual control or with an extension shaft or flexible cable from an access box. The units are hydrostatically tested. Flanges are 150 lb. flat faced and blank or drilled as specified. They are available with 180 deg., 105 deg., or 90 deg. bodies made of cast bronze, steel, semi-steel, cast iron, and alloyed metals for corrosion resistance. Manufactured by the J. A. Zurn Manufacturing Company, Erie, Pennsylvania.

(10) *Steam cleaning unit*

Available for immediate delivery for less than $100, the Turco Hydro Steam Unit weighs only 28 lb. and is easily portable. Quick couplings permit fast connection. Any steam line maintaining 80 to 150-lb. pressure with a ¾-in. valve outlet is all that is required for connecting up the unit, the manufacturer, Turco Products, Inc., states.

Three manual controls vary the temperature, quantity of solution, and nozzle pressure to handle the needs of the job at hand. It can be adjusted to deliver a high-temperature, penetrating spray or a moderately warm spray. A wide variety of Turco specialized cleaning compounds can be used through this unit to clean anything from delicate aluminum surfaces to heavy construction equipment caked with grease and dirt.

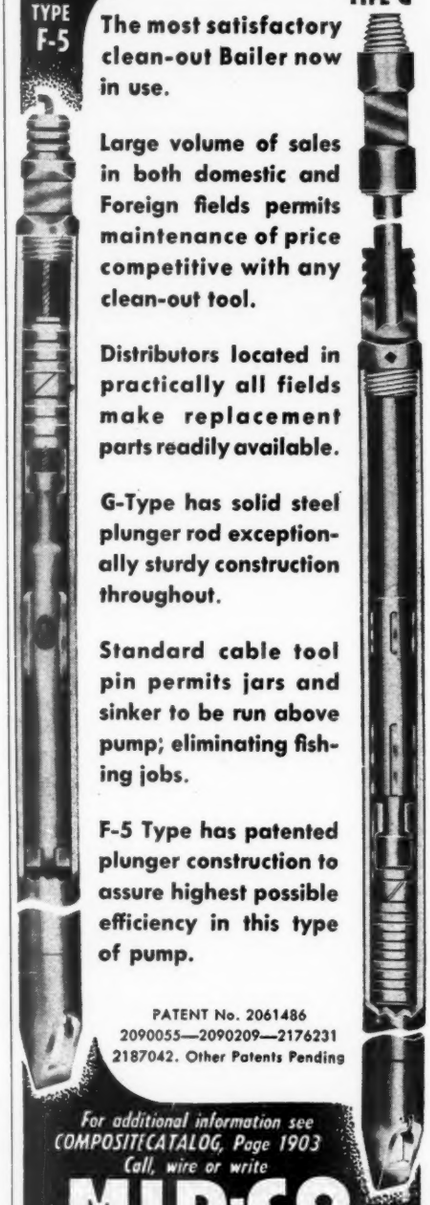
Safe, easy to operate, and practically foolproof, there are no moving parts, pumps, pressure tanks, motors, electrical connections, toxic or explosive cleaning agents, it is stated.

INCREASE PRODUCTION with

MID-CO CLEAN-OUT BAILER

TYPE F-5

TYPE G



The most satisfactory clean-out Bailer now in use.

Large volume of sales in both domestic and Foreign fields permits maintenance of price competitive with any clean-out tool.

Distributors located in practically all fields make replacement parts readily available.

G-Type has solid steel plunger rod exceptionally sturdy construction throughout.

Standard cable tool pin permits jars and sinker to be run above pump; eliminating fishing jobs.

F-5 Type has patented plunger construction to assure highest possible efficiency in this type of pump.

PATENT No. 2061486
2090055—2090209—2176231
2187042. Other Patents Pending

For additional information see COMPOSITE CATALOG, Page 1903
Call, wire or write

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Superior PTD DIESEL DRILLING ENGINE

. . . A modern engine specifically designed for the heavy duty requirements of oil field service.

Construction throughout is unusually rugged, with ample factors of safety in all parts. The engine is started in a few seconds by compressed air to all cylinders, and full load power is available at once. Lubricating oil consumption is exceptionally low and the engine operates efficiently on a wide range of fuels. Horsepower ratings of 280 for the 6 cylinder model and 375 for the 8 cylinder model are very conservative, providing ample reserve power for occasional overload or sudden emergency.

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GENERAL SALES OFFICES: TOLEDO, OHIO • DIVISION OFFICES: DENVER • FT. WORTH • PITTSBURGH • TULSA • TORRANCE. EXPORT: THE NATIONAL SUPPLY CORPORATION, 30 ROCKEFELLER PLAZA, NEW YORK, N. Y., U. S. A. • RIVER PLATE HOUSE, 12 SOUTH PLACE, LONDON, E. C. 2.

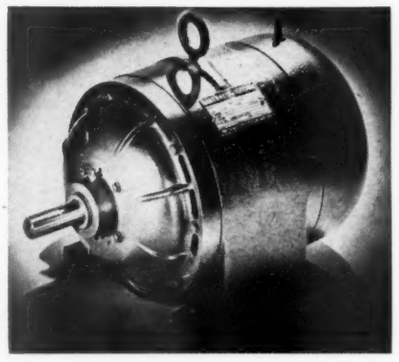
First in Quality — THE NATIONAL SUPPLY COMPANY — NATIONAL BLUE PRODUCTS

(11) *Fan-cooled motor*

A new totally enclosed, fan-cooled motor especially designed for use in extremely dirty, and corrosive atmospheres has been added to the line of General Electric Tri-Clad induction motors. The new motor is available in standard, explosion-proof, and dust-explosion-proof types from 1 to 1000 hp. and can be used where iron dust and metal fillings are in the air and in Class I Groups C and D and Class II Groups E, F, and G hazardous locations. Short in length and compact in construction, the motor can be installed in a small space, making it suitable for machine tool applications where the motor must be part of the driven machine.

The new Tri-Clad features a double-shell, cast-iron frame, and cast-iron end shields and conduit box for protection from external blows, dripping water, dusts, vapors, and corrosive liquids. Sealed end shields and inside joints, and a one-piece, double-shell stator protect windings, punchings and rotating parts from moisture or corrosive elements. Long, close-running shaft fits, supplemented by a rotating seal, keep dirt from entering the motor along the shaft. Punchings and windings within the inner shell of the motor are cooled by a non-sparking external fan that is protected by a cast-iron housing with a screened air-intake opening.

The cast-iron bearing housings are cast integral with the end shields as a barrier to the entrance of foreign materials. An inner cast-iron bearing cap makes a complete enclosure for the bearing. As on all



ball-bearing Tri-Clad motors, the pressure-relief greasing system is used. Greasing can be accomplished without disassembling or stopping the motor.

Low starting current, with balanced design, makes the new Tri-Clad suitable for full-voltage starting, thus permitting the use of simple, inexpensive control equipment. The motor has high pull-up torque for snappy acceleration, and high maximum running torque to meet temporary abnormal peaks and low-voltage conditions.

(12) *Flow manifold*

An innovation in Christmas tree design is the Unibolt Christmas tree flow manifold manufactured by Thornhill-Craver Company, Inc., Houston, Texas. This complete pretested unit includes all necessary wing fit-

tings above the master valve and makes use of Unibolt adjustable wing valves instead of gate or plug valves on the arms of the tree. The 1-in. opening in the valve is ample to assure low velocity flow through a small orifice in the positive bean installed in the choke body assembly beyond the adjustable wing valve. The Unibolt fitting on top of the manifold simplifies running pressure bombs or paraffin scrapers and is available flanged or threaded in any size combination desired. This flow manifold may be had in 6,000, 10,000 or 15,000-lb. test pressure units.

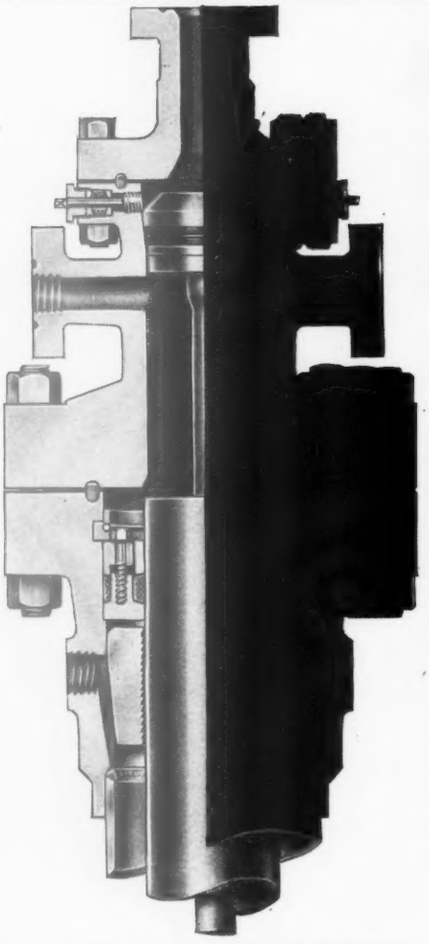
(13) *Geophysical wire*

Geologists searching for new deposits of oil will have lighter equipment to carry into remote places as the result of the development of a new geophysical wire by United States Rubber Company.

Utilizing experience gained during the war, scientists of the company have perfected a wire that weighs much less yet has greater strength and flexibility than the prewar wire used on seismographic equipment in oil explorations, it is asserted.

As equipment is often moved over rough terrain and, in some instances, must be carried by hand, the saving in weight is an important factor to searching parties.

The new wire is made with a small di-



REGAN TUBING and CASING HEADS

SCREW-LOCK TUBING HEAD—Provides positive means of tightening packing on tubing coupling without disconnecting flanges or disturbing the well. Especially useful in repressuring operations where pressures are reversed and tend to lift coupling off the packing seat.

PRESSURE-SEAL CASING HEAD—A full opening Casing Head with standard A.P.I. flanges and ring grooves with pressure-actuated packing unit securely locked in place with a special snap-ring. This eliminates all threads and screw rings which might become damaged, causing trouble and delay in landing casing and securing an effective seal.

AVAILABLE IN VARIOUS COMBINATIONS AND STYLES TO FIT YOUR PARTICULAR SITUATION—WRITE FOR DETAILS

Regan Forge & Engineering Co.
Quality
SAN PEDRO CALIFORNIA, U.S.A.
HOUSTON, TEXAS

EXPORT DISTRIBUTOR: 19 Rector Street, New York City, N. Y..
Avda Pte. R. Saenz Pena 832, Buenos Aires, Argentina.
P. O. Box 2125, Houston, Texas

FAIRBANKS-MORSE FIRST FOR ENGINES

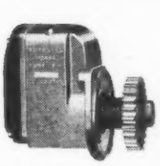
WHEN it comes to oil field power units, Fairbanks-Morse ZC Engines represent an unbeatable combination of economy, dependability, and service.

Their wide acceptance throughout the oil industry attests to their popularity. Oil men like the way Fairbanks-Morse ZC Engines keep on the job, operating unattended day after day, ignoring weather extremes, running smoothly on minimum lubrication and fuel. They appreciate, too, the ease and speed with which almost any fieldman can service these simple, single-cylinder engines.

Truly, using Fairbanks-Morse ZC Engines means using low-cost, trouble-free power.

Fairbanks, Morse & Co., Fairbanks-Morse Building, Chicago 5, Illinois.

Fairbanks-Morse MAGNETOS



...Worth Remembering, Too, for Faster Starts

Swift, sure starts are always at your finger tips with Fairbanks-Morse Super-Spark Magnetos. Available for any engine, they boost performance, save gas and oil, assure quick response on the coldest mornings.

Fairbanks-Morse

A name worth remembering

Oil Field Equipment • Diesel Engines
Diesel Locomotives • Generators
Motors • Pumps • Scales • Magnetos
Stokers • Railroad Motor Cars
and Standpipes • Farm Equipment

ameter conductor insulated by the company's unique dipping process. During the war this process was used in producing lightweight Army telephone wire that could be carried more easily by troops engaged in establishing communications at the front.

In oil prospecting the wire is used to pick up vibrations from man-made earthquakes. The earthquake is made by setting off a charge of dynamite. Waves are set up in the surrounding earth like waves in a pond when a stone is thrown in. Long lines of wire radiate out in all directions from a seismograph in a truck near the dynamite charge. To the end of each wire is attached a small microphone, known as a geophone. The shocks are picked up by these instruments and carried over the wire to be recorded automatically on charts. By studying the intensity and frequency of the tremors as shown on the charts, geologists can read the character of the earth's internal structure, from which they are able to determine the advisability of drilling for oil.

(14) *Bronze welding rod*

A new flux-coated bronze welding rod for application by the oxy-acetylene process has been developed by The Linde Air Products Company, unit of Union Carbide and Carbon Corporation. Known as Oxweld No. 25M. (Patented) Flux-Coated bronze rod, this new rod automatically combines all the superior properties of the familiar Oxweld No. 25M. bare bronze rod with correct fluxing, it is stated. When the rod is made, it is precoated with flux in proper proportion to its size. This coating consists of Brazo Flux plus a non-active binder that does not affect the weld. It adheres firmly to the rod, melting down into the molten puddle without burning off ahead of the rod. The rod can be heated and bent without destroying the coating. In addition, the coating is not affected by weather conditions.

Oxweld No. 25M. Flux-Coated bronze rod speeds up the welding operation and makes it easier to produce welds of uniformly high quality, it is asserted. The operator can give his entire attention to depositing the rod metal and controlling the molten puddle without the usual delays of dipping the end of the hot rod into the flux container. The flux melts into the weld continuously and in the right quantities, leaving no wasteful residue on the face of the weld. Thorough tinning, essential to good bronze-welding, continues without interruption.

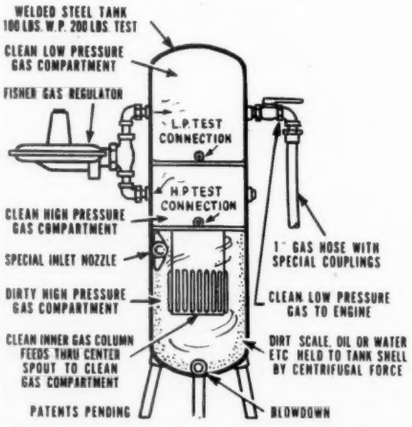
(15) *Single drum hoist*

The American Iron and Machine Works Company's new single drum suction hoist is designed to raise or lower the pump suction in the slush pit. The general design of the American double drum hoist has been borrowed in planning a device that is compact, efficient, and economical.

This hoist may be mounted on a conventional pipe stand across the pit or on an inverted Y frame mounted on the pump skids. The Y frame may be either of rigid construction or pivoted at the base for vertical adjustment. The hoist is mounted at any convenient position on the frame and the line is positioned over the suction line by the use of pulley blocks. The application of a worm and worm gear drive to the line drum makes it self locking at any load.

(16) *Gas scrubber*

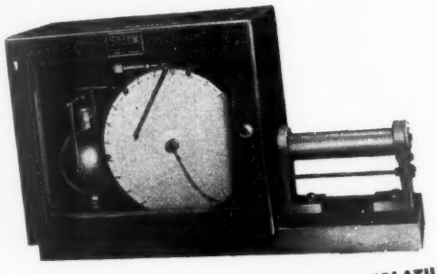
A gas scrubber of improved design that completely cleans field fuel gas before it is used by engines, is announced by Shrimpton Equipment Company. It consists of a 3-compartment tank with chambers that separate


WELDED STEEL TANK
100 LBS. W.P. 200 LBS. TEST
CLEAN LOW PRESSURE GAS COMPARTMENT
FISHER GAS REGULATOR
L.P. TEST CONNECTION
H.P. TEST CONNECTION
CLEAN HIGH PRESSURE GAS COMPARTMENT
SPECIAL INLET NOZZLE
1" GAS HOSE WITH SPECIAL COUPLINGS
DIRTY HIGH PRESSURE GAS COMPARTMENT
CLEAN LOW PRESSURE GAS TO ENGINE
CLEAN INNER GAS COLUMN FEEDS THRU CENTER SPOUT TO CLEAN GAS COMPARTMENT
DIRT SCALE, OIL OR WATER ETC HELD TO TANK SHELL BY CENTRIFUGAL FORCE
PATENTS PENDING
BLOWDOWN

the foreign materials from the incoming field gas and deposit them in the bottom, where they are removed through a blow-off cock. The upper compartment stores clean gas at a low pressure, permitting a smooth, even flow of gas into the carburetor. The equipment is simple in design and requires only periodic blow downs while in use, and is available in capacities to meet all requirements.

Why Major Company Engineers Select

ARCCO LIQUID GRAVITOMETERS



for DETERMINING SPECIFIC GRAVITY of HIGHLY VOLATILE LIQUIDS

1—OPERATES UNDER ACTUAL LINE PRESSURE—High working pressure prevents release of gas—an extremely important feature in measuring specific gravity of highly volatile liquids.

2—AUTOMATIC TEMPERATURE COMPENSATION—Produces highly accurate and fully corrected record of specific gravity of liquid under any designated standard temperature conditions.

3—CONTINUOUSLY FLOWING SAMPLE—Changes in specific gravity shown with minimum time log. Pressure necessary to produce required flow is only a few pounds per square inch, except for very viscous liquids.

4—NO MOVING JOINTS OR STUFFING BOXES—Friction and leakage eliminated. Instrument is delicately responsive to minute changes in specific gravity.

5—INDICATING AND RECORDING TYPES—Either type available with automatic temperature compensation. Can also be made of non-corrosive materials.

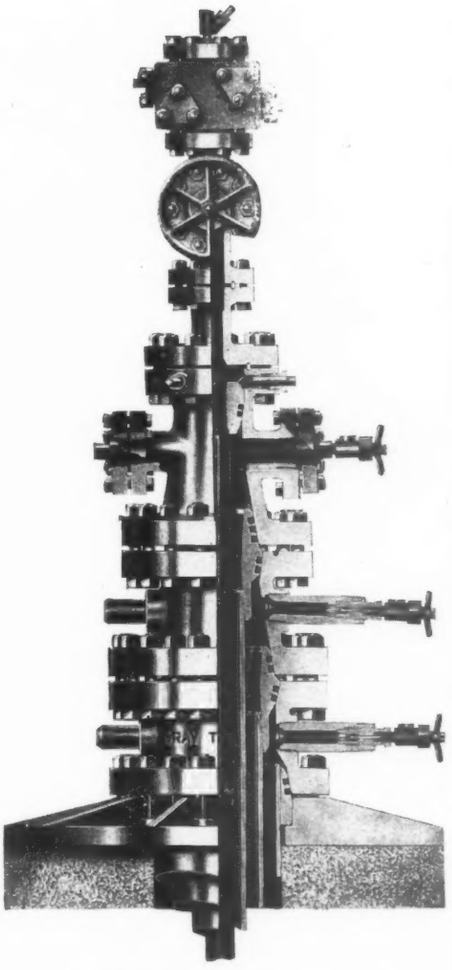
SEND FOR BULLETIN No. 111-A

AMERICAN RECORDING CHART CO.

3113 E. 11th St. Los Angeles 23, California

SEND FOR COMPLETE LIST OF ARCCO CHARTS

SIMPLICITY is the first requisite of well control



Complete Well Head Assembly equipped with Composite Manifold, Valve Removal, Installation and Removal.

Avoid unnecessary hazards by keeping parts to a minimum

Simplicity means the fewest number of the highest quality parts. Parts used beyond the minimum, parts left in the structure beyond their period of usefulness, are a menace and create unnecessary hazards. Many parts are manufactured of materials which are sufficiently long-lived and entirely suitable for use during their period of usefulness, but do not have the permanency which makes them safe for the flowing life of a well.

The blowout preventer, an essential and most valuable piece of equipment, is packed with rubber or other highly flowable material to facilitate ease in forming a seal. Such material is relatively weak when compared with steel, and disintegrates quickly. It is unsuitable where long life is essential and, therefore, should be used during the performance of operations where its use is needed, and then removed. The same applies to the master valve. The large pressure subject areas of the bonnet often cause gaskets to disintegrate when subjected to long periods of use.

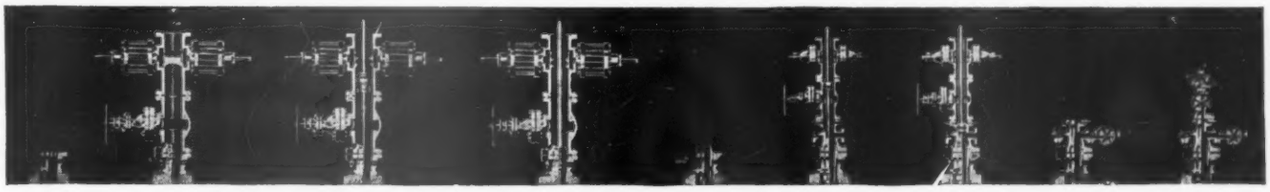
Gray Systems of Well Control provide complete control during and between all operations, plus the ability to use master valves, blowout preventers, strippers, and other available control equipment throughout their entire period of usefulness, after which provision is made for the disassembling and removal of these expensive parts, with control, to the position of accessories for use on other wells.

The whole is greater than any of its parts. Avoid unnecessary hazards by keeping parts in the permanent structure to a minimum.

GRAY
TOOL COMPANY
HOUSTON

Export Representative: GUY E. DANIELS, 30 Rockefeller Plaza, New York City

CONTROL DURING AND BETWEEN ALL OPERATIONS WITH GRAY PLANNED PROCEDURE



Casing Head Attached | Drilling | Running Casing | Casing Landed | Drilling Control Equipment Removed | Drilling-in and Running Tubing | Tubing Landed | Control Equipment Removed | Manifold Attached

(17) *Chemical Rotameter*

In chemical plants where corrosive fluids and gases require special piping materials such as Haveg, Karbate, Pyrex, porcelain, hard rubber, etc., metering problems are being capably solved by the new versatile Schutte and Koerting Chemical Rotameter, it is asserted. Designed so that the metered fluid comes into contact only with the required special material and the pyrex metering tube, the advantages of standard SK Rotameters—sturdy metal and easily-removed tube assembly—are retained. The special parts, even when made of these relatively fragile materials, are engineered to withstand the hazards of every day use and are amply supported against stresses in the piping and thermal shock.

Special corrosion-resistant rotors of platinum, silver, Haveg, Karbate, etc., are used in SK Chemical Rotameters. All meter parts are standard and design simplicity assures efficient operation and ease of installation, it is stated.

(18) *Electronic controls*

Hundreds of industrial processes in the chemical, metal, food, petroleum, and many other fields will be favorably affected by the introduction of a series of developments in industrial electronic control instruments, it is made known by L. Morton Morley, vice president in charge of sales of Brown Instrument Company, Philadelphia industrial division of Minneapolis-Honeywell Regulator Company.

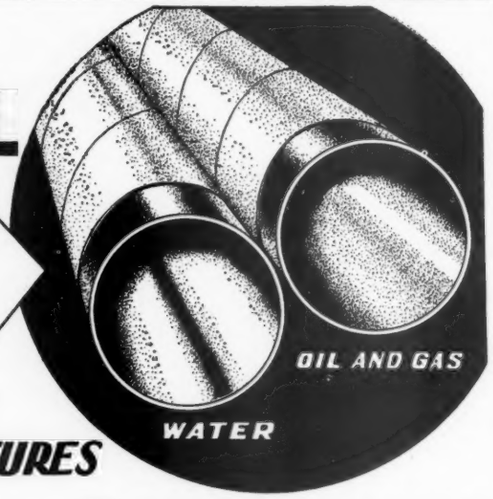
The new developments, according to Morley, extend the uses to which electronic control instrumentation can be put, particularly in obtaining higher quality control through continuous balance rather than intermittent action. Economies and speedier output also result, it is stated.

The developments announced by Brown company include a front-set mercury switch type control for circular chart electronic potentiometers, back-set mercury type auxiliary switch for both circular and strip chart electric potentiometers, thermocouple and component failure protection for both electronic models, and external chart drive switches, and omission of internal power switches.

The new instruments, parts and accessories, it is said, include numerous available variations tailored to a specific industry or process. The new developments were made available for delivery on April 1.

HILL — HUBBELL

machine applied STEEL PIPE PROTECTION



V HAS THESE IMPORTANT FEATURES

V POSITIVE BOND
V 2 COATS UNDER FELT
V CONTROLLED PROCESSING
V UNIFORM APPLICATION

Mechanically cleaned and primed steel pipe with conditioning of primer indoor controlled, guarantees positive bond: The enamel is applied over the primer in two separate applications to eliminate air bubbles and hollidays: Uniform specified thickness of primer and enamel thermostatically controlled at point of application over properly heated pipe at correct temperatures.

MOST MODERN PIPE PROTECTION PLANT

GENERAL PAINT CORPORATION
HILL, HUBBELL & CO. • Division • Cleveland, Ohio
• EXPORT OFFICE: SAN FRANCISCO, CALIFORNIA, U. S. A. •

(19) *FWD trucks*

With its production plans geared to the greatest peacetime truck demand in history, The Four Wheel Drive Auto Company of Clintonville, Wisconsin, is operating at peak capacity and is delivering its newly styled FWD trucks in unprecedented numbers despite the serious scarcity of materials, the management announced.

The 1946 model FWDs are built in 3 major weight classifications ranging from 3 to 15-ton rated capacity.

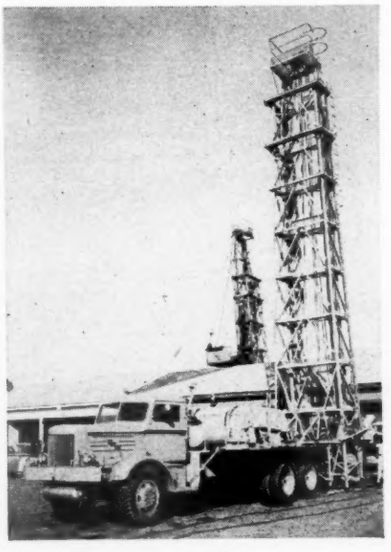
FWDs in the H series line, classified as light-heavies, are rated at 3 and 4-ton capacity. U series FWDs are being built in the 5-ton classification. The company's M series line of trucks are being built with 10-ton rated capacity.

FWD 6-wheel drive tractors and trucks rated at 15-ton capacity are also included in the company's standard line and are listed as available for immediate delivery.

The 1946 FWD has been completely restyled for improved appearance and utility. Salient features of this restyling include modernized radiator grills, streamlined fenders and skirting, and the new, more comfortable, "Universal Safety Cab."

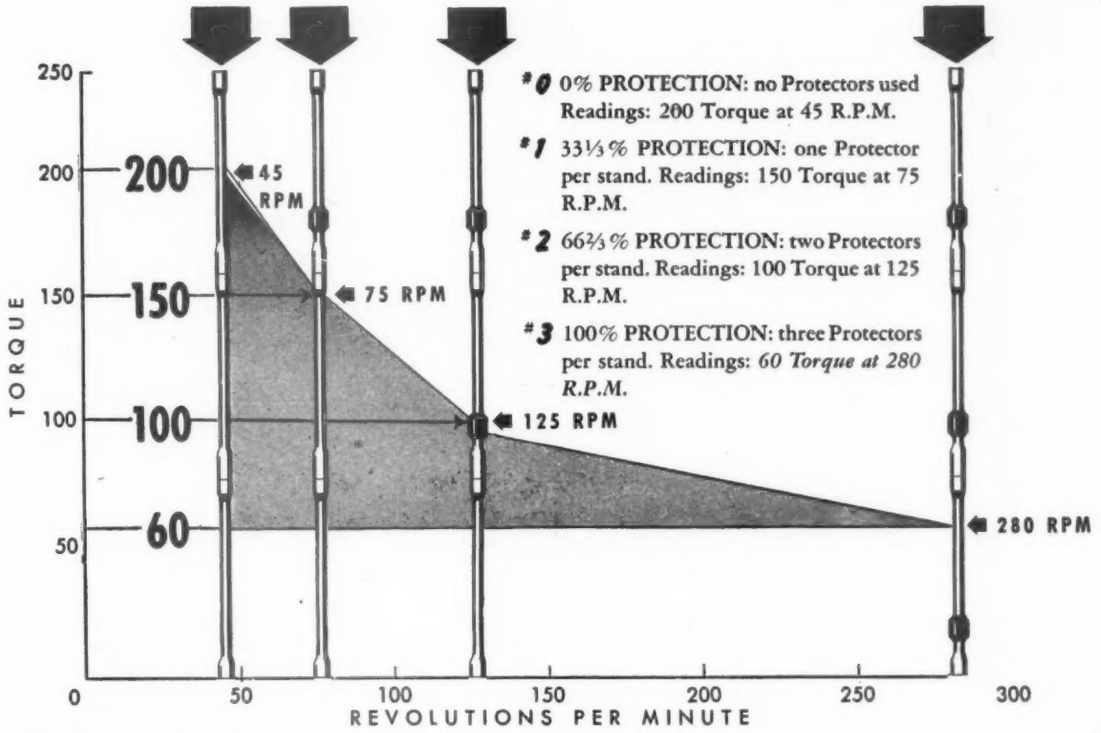
Axles, transmissions, and frames have been redesigned and reengineered for greater safety, greater speed, and greater durability. Built on mass production assembly lines, the company's listed models are all of standard design and can be equipped for use in all heavy duty trucking work.

FWD 6-wheel drive 58,000-ton gross vehicle weight truck equipped with an oil well servicing rig owned by the Richfield Oil Company of California.



CASING PROTECTORS • STABILIZERS • PIPE WIPERS • WIRE LINE GUIDES • WIRE LINE WIPERS • KELLY WIPERS
KELLY SUB PROTECTORS • MUD GUNS • MUD GUN NOZZLES • SWIVEL BAIL BUMPERS • DEAD LINE STABILIZERS
TRAVELING BLOCK BUMPERS • TUBING PROTECTORS • SUCKER ROD WIPERS • TUBING WIPERS

One! Two! Three! and your TORQUE is O-U-T!



CASE HISTORY No. 3
CHOCOLATE BAYOU
Well number on Request

Watch Torque drop as you add protectors! Here's proof about friction . . .

This chart is an actual case at Chocolate Bayou on a rig of a large oil operator. The figures are actual Torque and R.P.M. instrument readings. #0—Without Protectors; #1—Drill Pipe ⅓ protected with one Protector per stand; #2—Drill Pipe ⅔ protected with two Protectors per stand; and, #3—DRILL PIPE 100% PROTECTED with *3 Protectors per stand.*

Note that the greatest reduction of Torque due to friction was when the final ⅓ of the Drill Pipe was covered, proof that for full protection, one Protector at each tool joint should be used

6¾ inch O.D. Patterson-Ballagh lip style Casing Protectors were used, installed on 7,000 feet of 4½ inch drill pipe in 9⅝ inch casing. Your tool joint and casing wear is greatly reduced by the use of these money-saving PBX Synthetic Rubber Casing Protectors.

Your nearest Patterson-Ballagh representative will gladly give information as to proper sizes and tell you how to obtain 100% protection NOW.

"Best Bet Yet"

PATTERSON-BALLAGH
LOS ANGELES 1 • HOUSTON 10 • NEW YORK 6

PATTERSON-BALLAGH
DRILL PIPE AND CASING
PROTECTORS
Now Made of PBX Synthetic Rubber . . . Oil and Weather Resistant

TRADE LITERATURE

Publications listed are sent free upon request.

(20) *Worthington bulletins*

Two bulletins have recently been issued by Worthington Pump and Machinery Corporation, Harrison, New Jersy. Bulletin W-350-B8 describes Worthite pumps for slurry handling. Bulletin W-414-B50 discusses the company's automatic Variflo triplex power pumps.

(21) *Nukemite*

A Brochure issued by Nukem Products Corporation, Buffalo, New York, is the first release of literature describing Nukemite, a new product developed during the war and now available for general industrial use. Nukemite is a plastic coating asserted to be acid and alkali proof.

(22) *Oilite bronze bearings*

Catalog 451, issued by Geo. J. Fix Company, Dallas, Texas, contains complete information on Chrysler Oilite oil cushion bronze bearings, and other Chrysler-made products produced by the new technique of powdered metallurgy. The catalog contains a wealth of engineering data to assist in the selection of proper bearings, gives details about the special nature and advantages of Oilite, and a complete price and stock list of bearings.

(23) *Otis safety valves*

Otis safety valves is the subject of a folder issued by Otis Pressure Control, Inc., Dallas, Texas. Various type safety valves and their particular application are discussed. An outstanding feature of the Otis safety valves, it is pointed out, as well as other sub-surface controls manufactured by the company, is that they can be run and pulled on an ordinary steel measuring line without loading the well or pulling the tubing to make or service the installations.

(24) *Direct rotary drive*

The Ideal Type "E" direct rotary drive unit, described in a recent bulletin issued by The National Supply Company, is a compact skid-mounted assembly providing an internal-combustion engine drive through a hydraulic torque converter and a gear box to the rotary, which is mounted on the skids. The Ideal Type FE-17½ and MS-20½ rotaries are offered for mounting on this unit. Other rotaries of the proper gear ratio and shaft height may also be installed. This unit provides additional power to the rig for drilling and allows full control of the pump and the rotary separately, eliminating the necessity of selecting a drawworks transmission ratio to obtain desired speed of both the pump and the rotary, it is stated.

(25) *Horton floating roof*

The Chicago Bridge and Iron Company, Chicago, Illinois, announces the publication of a new 12-page booklet "The Horton Floating Roof" discussing the reduction of evaporation loss and the elimination of fire hazard in flat-bottom tanks storing volatile liquids and chemicals.

Included in this booklet is an explanation of the insulating effect of the double-deck on a Horton floating roof in eliminating practically all boiling, thus extending the range of products previously stored in floating roof tanks. Several sketches show the details of the new Horton seal, which closes the space between the shell and the deck of the roof. The sealing ring forming a long sliding contact with the tank shell is also shown in these sketches.

Gauging methods employed with flat-bottom tanks equipped with the improved Horton floating roof are described and a diagram of a typical installation is shown.

(26) *McEvoy general catalog*

A new 48-page postwar general catalog has been published by the McEvoy Company, Houston, Texas. It is printed in 3 colors throughout giving it not only an attractive appearance, but making possible the tying up of each important quarter-section and cross-section wash drawing with a blue print for further elucidation. The 3 colors also aid in explaining the more intricate operations, an example of which is the use of schematic drawings in explaining the operation of the McEvoy self operating gas lift.

The catalog is divided into three sections each set off by a division page naming the section. The catalog gives complete specifications together with pressures, weights, and other information needed by the buyers.

(27) *Universal heat exchanger*

A new bulletin from The Griscom-Russell Company describes the Twin G-Fin Section, which has been characterized as a universal heat exchanger because of its many applications in cooling, heating, condensing, and heat exchange services. The bulletin tabulates 21 features and corresponding advantages of this finned tube unit, and describes in detail the design and construction. Many installation views are shown, and field reports of service men are also included.

(28) *Mixing and grinding*

"Clevelands in the Modern Production Flow" is the name of a pictorial bulletin in 3 colors by The Cleveland Worm and Gear Company describing the applications of worm gear speed reducers to various types of mixing and grinding equipment. Subtitled "Mixing and Grinding" the bulletin contains photographic illustrations featuring installations of worm gear units on equipment used by 11 leading industries for the processing of their materials.

(29) *Tide Water Bayonne TCC unit*

A TCC Unit revamped from an existing thermal cracking unit designed and built by The Lummus Company at Tide Water Associated Oil Company, Bayonne, New Jersey, has recently completed a very successful eight month initial run. The story of this performance is told in a 4-page leaflet.

(30) *Methods of producing hydrogen*

With easily understood text, numerous pictures, flow diagrams and tables, a new 32-page booklet issued by the Gas Processes Division of The Girdler Corporation reviews the commercially useful methods of producing hydrogen. Included is a description of the new Girdler Hygirtol plant for the production of high purity hydrogen by reacting hydrocarbons with steam.

(31) *Asphalt flooring*

The Philip Carey Manufacturing Company, Lockland, Ohio, has released a new folder on Careycrete, an industrial asphalt flooring used as a surfacing for floors and to patch old floors. The folder gives simple directions for quick patching jobs and describes the wide usage on new floors. This Carey flooring is applied cold. A ½-in. layer will withstand loads up to 5 tons, it is stated.

(32) *Shaft seal*

Ingersoll-Rand Co. announces the publication of a two-color 16-page bulletin entitled "The Shaft-Seal—The Answer to Your Stuffing Box Problems." This booklet is a graphic description of the Cameron Shaft-Seal, an item of utmost importance to the field of hydraulics.

The Shaft-Seal in its present, perfected form, is the end product of more than 17 years of constant study of the problem of preventing leakage along the drive-shaft of centrifugal pumps.

This booklet should be of the greatest interest to hydraulic engineers and users of centrifugal pumps particularly in the refinery and chemical industries. The booklet is full of cross-sections, "exploded views," and pictures of typical Shaft-Seal installations.

(33) *Selectrode chart*

The Selectrode Chart recently issued by the Hollup Corporation, a division of the National Cylinder Gas Company, Chicago, Illinois, guides electrode users in the choice of the correct electrodes for a specific job. It tells which electrode to use, suggests applications, shows currents, positions, physical characteristics, etc.

Included are electrodes recommended for mild, low alloy and stainless steels, non-ferrous and cast-iron, surfacing, as well as gas welding rods.

(34) *Plasticlad*

An illustrated circular describing Plasticlad, an alloy-steel, electrostatically coated roofing and siding material, has been issued by the Reliance Steel Products Company, McKeesport, Pennsylvania. Extraordinary toughness of the copolymer resin coat, immunity to atmospheric corrosion or chemical attack, and very high fire resistance are among the stated merits of this new material. Attractive colors, permanently incorporated in the plastic coat, are offered as an added advantage. Ventilators, flashings, and fastenings as well as roofing and siding are made of Plasticlad.

(35) *Corrosion control*

A recently issued 12-page bulletin offers tested solutions for the difficult corrosion problems in the petroleum industry. Prepared by the Amercoat Division of the American Pipe and Construction Company, Los Angeles, California, the book consists of factual reports on actual uses and tests of Amercoat plastic coatings in the petroleum industry.

THE *Petroleum* Engineer's CONTINUOUS TABLES

A DAILY REFERENCE FOR OPERATING MEN

INSTALLMENT No. 106

A VALUABLE and regular feature of *The Petroleum Engineer*, the Continuous Tables, now in their eighth year of publication, were designed to save time and effort for the technician and the practical field or plant worker. The tables have proved one of the most popular and helpful departments of *The Petroleum Engineer*. Data are presented in the simplest form available with many types of information included that are best presented by curves or nomographs when three or more variables must be considered simultaneously.

The Continuous Tables have developed as a result of suggestions for new tables, direct contributions, and improvements to existing tables by members of the petroleum and related industries, including manufacturing concerns, who are continually searching for practical information reduced by computation to tabular form readily applicable to the problems daily confronting them that might otherwise necessitate a more or less tedious calculation. These contributions and suggestions from the industry have resulted in a valuable exchange of information and data contributing to the progress of the industry as a whole.

This index will be revised monthly. The index for installments 1-12, inclusive, will be found in the May, 1938, issue; 13-24, inclusive, in the June, 1939, issue; 25-36, inclusive, in the June, 1940, issue; 37-48, inclusive, in the June, 1941, issue; 48-60, inclusive, in the June, 1942, issue; 61-72, inclusive, in the June, 1943, issue; 73-79, inclusive, in the January, 1944, issue; 80-82, inclusive, in the April, 1944, issue; 83-85, inclusive, in the July, 1944, issue; 86-88, inclusive, in the October, 1944, issue; 89-91, inclusive, in the January, 1945, issue; 92-94, inclusive, in the April, 1945, issue; 95-97, inclusive, in the July, 1945, issue; 98-100, inclusive, in the October, 1945, issue, and 101-103, inclusive, in the January, 1946, issue.

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"Right there, you see the principal cause of CROOKED HOLE"

"I'm not joking. Those whippy bamboo canes vaudeville actors used to have act pretty much like a drill string where the driller's crowding his bit. Yes, I know all the other causes of hole deviation—I've drilled enough wells to meet 'em all. But when all's said and done, most crooked hole results from just one thing—too much weight on the bit.

"Here's why. If you let the drill string hang free, it'll hang perfectly vertical, in tension, like this. And if you could cut formation that way, you'd never have hole deflection, would you? But you've got to put weight on the bit; that puts part of the string in compression. If the drilling weight is less than the weight of bit and drill collar, just the drill collar will be in compression, leaving the rest of the string stretched vertical. And that's the simple secret of vertical drilling—keep the drill string in tension, *vertical*.

"But suppose you put more weight on the bit—the drill string, some or all of it, will spring into a bow, just like that bamboo cane. Imagine a bit on the tip of that cane: you'll agree that it couldn't drill a vertical hole. And now—notice this—the minute the hole starts off at an angle, you've opened the door for two other forces that will make the angle worse. One is the fact that, when you're drilling on an angle, only part of the drilling weight drives the bit downward; the rest of the weight is pushing the bit *sidewards*. I haven't the engineers' technical words to explain it, but take my word it does it. And the second thing is this: get the bit cocked at an angle, and as it turns it'll climb to the *high* side of the hole, increasing the angle. Sure it will. Test it yourself: stand a pencil on the table—tilt it—rotate it—it'll walk away from the vertical, every time. And a drill string acts the same way.

"Those things won't bother you if you keep the hole vertical. Use an accurate inclination recorder, take frequent readings, and be guided by them in selecting the best drilling weight and speed. I use a Totco Recorder myself, because it's accurate right down to ⅛ of a degree, it's quick and easy to use, and it's reliable always. I've drilled a lot of good wells with a Totco in the last 10 years."

Based upon the actual statements of hundreds of drillers and drilling superintendents in all parts of the country, and in many foreign fields.

TOTCO

TECHNICAL OIL TOOL CORP., Ltd.

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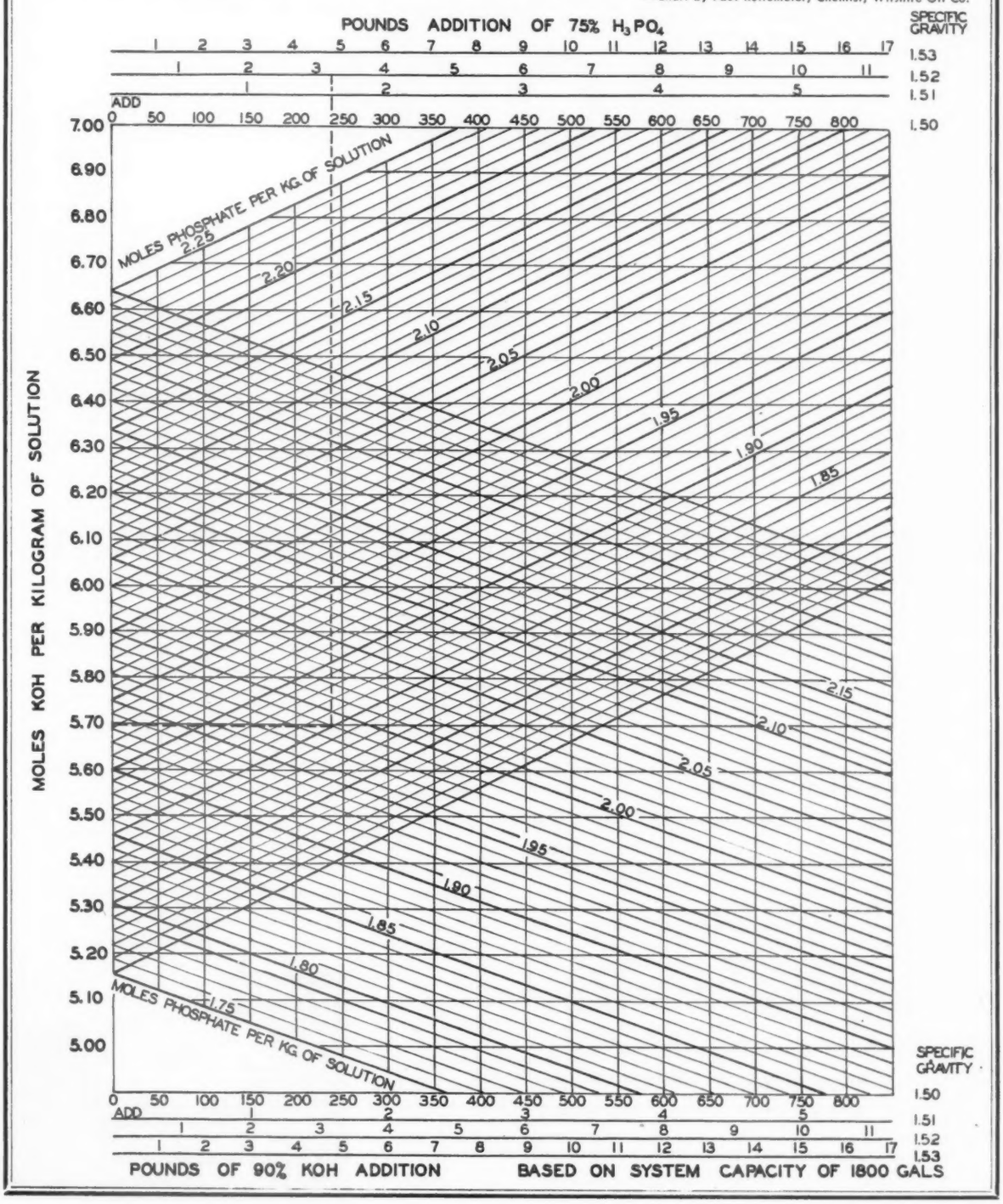
HYDROGEN SULPHIDE REMOVAL BY POTASSIUM PHOSPHATE SOLUTION

Many refineries and other plants processing hydrocarbons use potassium phosphate for removal of hydrogen sulphide. When the spent solution is regenerated, an analysis is made to determine the concentrations of potassium ion and of phosphate ion. Calculations can then be made, based on the capacity of the system and the specific gravity, to find the proper weight of either component that must be added to restore the original equilibrium between K^+ ions and $PO_4^{\equiv}$ ions at the optimum ratio of $\frac{K^+}{PO_4^{\equiv}} = 2.95$.

The chart below is intended only to be an aid in rapid computation of the required chemical addition after the analysis has been completed.

Example: Analysis of the regenerated solution shows the potassium ion concentration to be 5.70 moles per kilogram, the phosphate ion concentration 1.85 moles per kilogram, and the specific gravity 1.52. *Solution:* As indicated by the dotted lines on the chart, 243 pounds of 75 per cent phosphoric acid must be added to restore the ratio of 2.95. This is based on a system capacity of 1800 gal., but a conversion factor would adapt it to systems of other capacities.

—Chart by Paul Reitemeier, Chemist, Wilshire Oil Co.



ASSURES the User BETTER PIPING

Continuous interchange of experience data and manufacturing information between Midwest's four pipe fabricating plants results in a pool of piping experience that is unsurpassed by any other organization.

Each plant is fully equipped to do a complete job of pipe fabricating—is staffed by piping experts of long experience and high qualifications. Each plant is always striving to improve its product. A friendly rivalry acts as a stimulant.

Information on new processes and techniques, solutions to unusual piping problems, and generally useful data are exchanged between these plants. One plant will develop an improvement in welding procedure for a difficult alloy . . . another will build a new fixture for saving time in welding . . . etc. For many years this exchange has been building up an unsurpassed pool of piping experience and "know how."

This is just one of several reasons why Midwest can do a better piping job for you . . . whether you want a simple bend or piping for an entire plant installed without divided responsibility.

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Plants: St. Louis, Passaic (N. J.) and Los Angeles • Subsidiary: Lumsden & Van Stone Co., South Boston 27, Mass. • Sales Offices: New York 7—30 Church St. • Chicago 3—645 Marquette Bldg. • Los Angeles 33—520 Anderson St. • Houston 2—229 Shell Bldg. • Tulsa 3—533 Mayo Bldg. • Atlanta 3—Red Rock Bldg. • South Boston 27—426 First St.

PIPING FABRICATORS AND CONTRACTORS

RECIPROCALS, CIRCUMFERENCES, AND AREAS OF CIRCLES

Diam. n	Reciprocal $1000/n$	Circumference of circle πn	Area of circle $\frac{1}{4}\pi n^2$	Diam. n	Reciprocal $1000/n$	Circumference of circle πn	Area of circle $\frac{1}{4}\pi n^2$
800	1.250 000	2 513.274	502 654.8	850	1.176 471	2 670.354	567 450.2
801	1.248 439	2 516.416	503 912.2	851	1.175 088	2 673.495	568 786.1
802	1.246 883	2 519.557	505 171.2	852	1.173 709	2 676.637	570 123.7
803	1.245 330	2 522.699	506 431.8	853	1.172 333	2 679.779	571 462.8
804	1.243 781	2 525.840	507 693.9	854	1.170 960	2 682.920	572 803.4
805	1.242 236	2 528.982	508 957.6	855	1.169 591	2 686.062	574 145.7
806	1.240 695	2 532.124	510 222.9	856	1.168 224	2 689.203	575 489.5
807	1.239 157	2 535.265	511 489.8	857	1.166 861	2 692.345	576 834.9
808	1.237 624	2 538.407	512 758.2	858	1.165 501	2 695.486	578 181.9
809	1.236 094	2 541.548	514 028.2	859	1.164 144	2 698.628	579 530.4
810	1.234 568	2 544.690	515 299.7	860	1.162 791	2 701.770	580 880.5
811	1.233 046	2 547.832	516 572.9	861	1.161 440	2 704.911	582 232.2
812	1.231 527	2 550.973	517 847.6	862	1.160 093	2 708.053	583 585.4
813	1.230 012	2 554.115	519 123.8	863	1.158 749	2 711.194	584 940.2
814	1.228 501	2 557.256	520 401.7	864	1.157 407	2 714.336	586 296.6
815	1.226 994	2 560.398	521 681.1	865	1.156 069	2 717.478	587 654.5
816	1.225 490	2 563.540	522 962.1	866	1.154 734	2 720.619	589 014.1
817	1.223 990	2 566.681	524 244.6	867	1.153 403	2 723.761	590 375.2
818	1.222 494	2 569.823	525 528.8	868	1.152 074	2 726.902	591 737.8
819	1.221 001	2 572.964	526 814.5	869	1.150 748	2 730.044	593 102.1
820	1.219 512	2 576.106	528 101.7	870	1.149 425	2 733.186	594 467.9
821	1.218 027	2 579.248	529 390.6	871	1.148 106	2 736.327	595 835.2
822	1.216 545	2 582.389	530 681.0	872	1.146 789	2 739.469	597 204.2
823	1.215 067	2 585.531	531 973.0	873	1.145 475	2 742.610	598 574.7
824	1.213 592	2 588.672	533 266.5	874	1.144 165	2 745.752	599 946.8
825	1.212 121	2 591.814	534 561.6	875	1.142 857	2 748.894	601 320.5
826	1.210 654	2 594.956	535 858.3	876	1.141 553	2 752.035	602 695.7
827	1.209 190	2 598.097	537 156.6	877	1.140 251	2 755.177	604 072.5
828	1.207 729	2 601.239	538 456.4	878	1.138 952	2 758.318	605 450.9
829	1.206 273	2 604.380	539 757.8	879	1.137 656	2 761.460	606 830.8
830	1.204 819	2 607.522	541 060.8	880	1.136 364	2 764.602	608 212.3
831	1.203 369	2 610.663	542 365.3	881	1.135 074	2 767.743	609 595.4
832	1.201 923	2 613.805	543 671.5	882	1.133 787	2 770.885	610 980.1
833	1.200 480	2 616.947	544 979.1	883	1.132 503	2 774.026	612 366.3
834	1.199 041	2 620.088	546 288.4	884	1.131 222	2 777.168	613 754.1
835	1.197 605	2 623.230	547 599.2	885	1.129 944	2 780.309	615 143.5
836	1.196 172	2 626.371	548 911.6	886	1.128 668	2 783.451	616 534.4
837	1.194 743	2 629.513	550 225.6	887	1.127 396	2 786.593	617 926.9
838	1.193 317	2 632.655	551 541.1	888	1.126 126	2 789.734	619 321.0
839	1.191 895	2 635.796	552 858.3	889	1.124 859	2 792.876	620 716.7
840	1.190 476	2 638.939	554 176.9	890	1.123 596	2 796.017	622 113.9
841	1.189 061	2 642.079	555 497.2	891	1.122 334	2 799.159	623 512.7
842	1.187 648	2 645.221	556 819.0	892	1.121 076	2 802.301	624 913.0
843	1.186 240	2 648.363	558 142.4	893	1.119 821	2 805.442	626 315.0
844	1.184 834	2 651.504	559 467.4	894	1.118 568	2 808.584	627 718.5
845	1.183 432	2 654.646	560 793.9	895	1.117 318	2 811.725	629 123.6
846	1.182 033	2 657.787	562 122.0	896	1.116 071	2 814.867	630 530.2
847	1.180 638	2 660.929	563 451.7	897	1.114 827	2 818.009	631 938.4
848	1.179 245	2 664.071	564 783.0	898	1.113 586	2 821.150	633 348.2
849	1.177 856	2 667.212	566 115.8	899	1.112 347	2 824.292	634 759.6

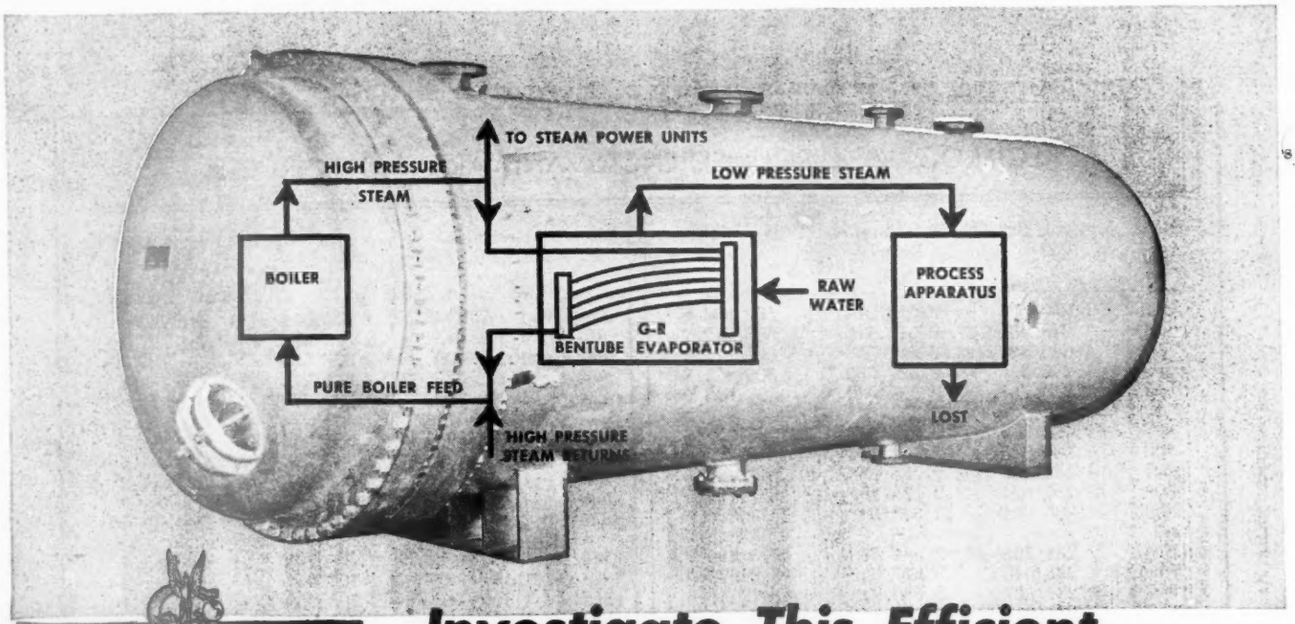
Note: n may be in any unit of measure, such as in., ft., yards, miles, meters, or fractions thereof.

Example: The diameter of a circle = 8.5 in.

Then, the circumference = $8.5 \times \pi = 26.70354$ in. (The figure shown opposite 850 pointed off for the fraction); and the area = 56.74502 sq. in. *Notice* that the decimal point is moved *the same number of places* to the left in pointing off for the circumference, and twice the *number of places* to the left for the area.

The *reciprocal* of a number is simply the quotient of unity (1000 is taken as unity in this table) divided by the number. It is useful in determining decimal equivalents of fractions.

Example: Opposite 833 (above), the reciprocal $\left(\frac{1000}{833}\right) = 1.200480$. Then, the decical equivalent of the fraction 1/833 in. = 0.00120048 in. And, the decimal equivalent of the fraction 1/83.3 in. = 0.0120048 in. *Notice* that the decimal point is moved *the same number* of places in the denominators of the two fractions as in the answers, but in opposite directions.



Investigate This Efficient
THERMAL REDUCING VALVE
If You Use Process Steam

The above simplified flow chart shows how a G-R Bentube Evaporator can serve to produce large quantities of low-pressure steam for process work. The advantages:

THE G-R BENTUBE EVAPORATOR

1. **The high-pressure steam used to operate the evaporator is all returned to the boiler, after use, in the form of condensate.**
2. **No raw, scale-forming make-up or contaminated condensed process steam is fed to the boiler, thus reducing boiler maintenance.**
3. **The scale-shedding heating elements of the G-R Bentube Evaporator maintain rated heat transfer without requiring hand scaling.**
4. **The evaporator is practically 100% thermally efficient.**
5. **Ideal plant heat balance can be arranged.**

Many millions of pounds per hour of process steam are now being produced in highly successful G-R Bentube Reducing-Valve Evaporator plants. For more complete details, write for free copy of our Bulletin 364.

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285 Madison Ave. New York 17, N. Y.

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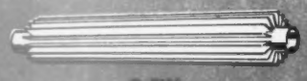
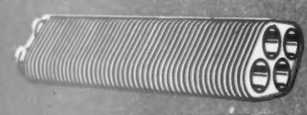


G-FIN
Longitudinal-finned elements for greater heat conductivity

K-FIN
Helical-finned elements for vapors and gases

BENTUBE SECTIONS
with scale-shedding elements for hard or salt water



TUBEFLO SECTIONS
Non-clogging design for residuum and other dirty fluids

GRISCOM-RUSSELL

Pioneers in Heat Transfer Apparatus

PLUNGER AND ROD SIZE SELECTION CHARTS FOR DEEP WELLS

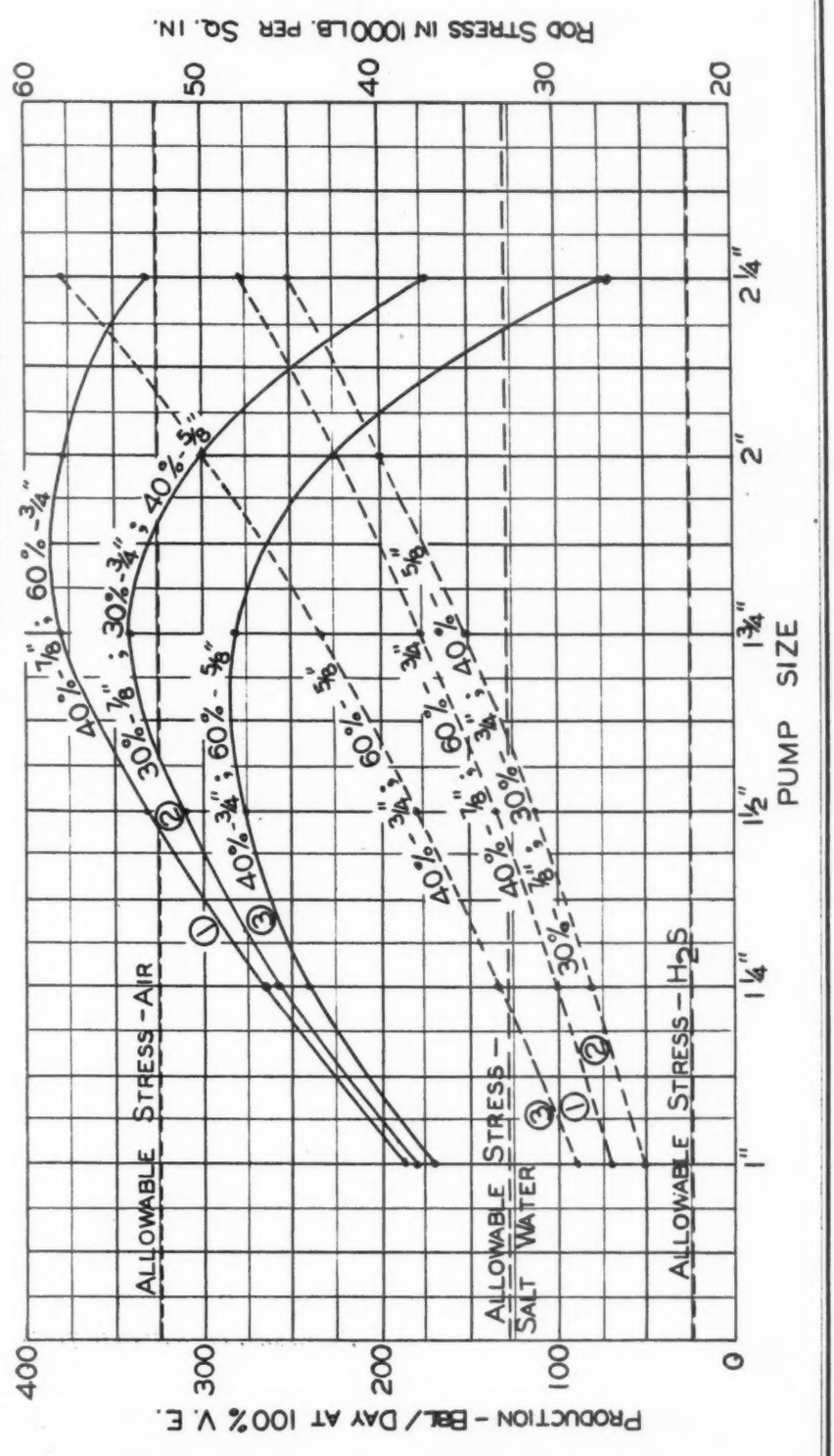
This series of plunger and rod size selection charts have been designed to illustrate roughly the load and plunger travel conditions that should be anticipated in pumping deep wells. Mills' formula was used in calculating the polished rod load, and Sloneger's formula was used in calculating peak torque. The production of the pumps has been corrected for sucker rod stretch, but not for volumetric efficiency. The specific gravity of the fluid pumped is assumed to be 1.00. The "allowable stress" is necessarily an arbitrary endurance limit, and, if exceeded, an unduly high number of rod failures may be anticipated.

Solid lines are the production curves, and the dashed lines are the rod stress curves for the various combination rod strings.

Conditions for Curve No. 1 (below):

Pumping depth, 6000 ft.
Strokes per min., 20.
Length of stroke, 74 in.
Size of tubing, 2½ in.
Peak polished rod load = 0.6 × rod stress (curves 1 and 2).
Peak polished rod load = 0.44 × rod stress (curve 3).

—Chart by H. E. Berg, Petroleum Engineer, Tide Water Associated Oil Company, and W. H. Minor, Lufkin Foundry and Machine Company.



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Hazard offers you a wire rope sling service—never before available. In the first place, Hazard supplies the exact type of sling you need for your particular job—whether standard wire rope, braided wire rope or cable-laid. You also have choice of standard terminals or newly developed, load-tested endings such as the ACCO-LOC Safety Splice and the U-LOC.

More than this, every Hazard Registered Sling is proof-tested to twice its rated capacity before it leaves the mill. Then it is numbered and indelibly marked with a metal tag stating its maximum safe load. You get a Certificate of Test and Registry which certifies to the sling's pre-determined safety. All Hazard Registered slings are made of LAY-SET Preformed Wire Rope—easy, fast and safe to handle. Write for literature.

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AMERICAN CHAIN & CABLE

TRADE MARK

In Business for Your Safety

RECIPROCALS, CIRCUMFERENCES, AND AREAS OF CIRCLES

Diam. n	Reciprocal $1000/n$	Circumference of circle πn	Area of circle $\frac{1}{4}\pi n^2$	Diam. n	Reciprocal $1000/n$	Circumference of circle πn	Area of circle $\frac{1}{4}\pi n^2$
900	1.111 111	2 827.433	636 172.5	950	1.052 632	2 984.513	708 821.8
901	1.109 878	2 830.575	637 587.0	951	1.051 525	2 987.655	710 314.9
902	1.108 647	2 833.717	639 003.1	952	1.050 420	2 990.796	711 809.5
903	1.107 420	2 836.858	640 420.7	953	1.049 318	2 993.938	713 305.7
904	1.106 195	2 840.000	641 839.9	954	1.048 218	2 997.079	714 803.4
905	1.104 972	2 843.141	643 260.7	955	1.047 120	3 000.221	716 302.8
906	1.103 753	2 846.283	644 683.1	956	1.046 025	3.003.363	717 803.7
907	1.102 536	2 849.425	646 107.0	957	1.044 932	3 006.504	719 306.1
908	1.101 322	2 852.566	647 532.5	958	1.043 841	3 009.646	720 810.2
909	1.100 110	2 855.708	648 959.6	959	1.042 753	3 012.787	722 315.8
910	1.098 901	2 858.849	650 388.2	960	1.041 667	3 015.929	723 822.9
911	1.097 695	2 861.991	651 818.4	961	1.040 583	3 019.071	725 331.7
912	1.096 491	2 865.133	653 250.2	962	1.039 501	3 022.212	726 842.0
913	1.095 290	2 868.274	654 683.6	963	1.038 422	3 025.354	728 353.9
914	1.094 092	2 871.416	656 118.5	964	1.037 344	3 028.495	729 867.4
915	1.092 896	2 874.557	657 555.0	965	1.036 269	3 031.637	731 382.4
916	1.091 703	2 877.699	658 993.0	966	1.035 197	3 034.779	732 899.0
917	1.090 513	2 880.840	660 432.7	967	1.034 126	3 037.920	734 417.2
918	1.089 325	2 883.982	661 873.9	968	1.033 058	3 041.062	735 936.9
919	1.088 139	2 887.124	663 316.7	969	1.031 992	3 044.203	737 458.2
920	1.086 957	2 890.265	664 761.0	970	1.030 928	3 047.345	738 981.1
921	1.085 776	2 893.407	666 206.9	971	1.029 866	3 050.486	740 505.6
922	1.084 599	2 896.548	667 654.4	972	1.028 807	3 053.628	742 031.6
923	1.083 424	2 899.690	669 103.5	973	1.027 749	3 056.770	743 559.2
924	1.082 251	2 902.832	670 554.1	974	1.026 694	3 059.911	745 088.4
925	1.081 081	2 905.973	672 006.3	975	1.025 641	3 063.053	746 619.1
926	1.079 914	2 909.115	673 460.1	976	1.024 590	3 066.194	748 151.4
927	1.078 749	2 912.256	674 915.4	977	1.023 541	3 069.336	749 685.3
928	1.077 586	2 915.398	676 372.3	978	1.022 495	3.072.478	751 220.8
929	1.076 426	2 918.540	677 830.8	979	1.021 450	3 075.619	752 757.8
930	1.075 269	2 921.681	679 290.9	980	1.020 408	3 078.761	754 296.4
931	1.074 114	2 924.823	680 752.5	981	1.019 368	3 081.902	755 836.6
932	1.072 961	2 927.964	682 215.7	982	1.018 330	3 085.044	757 378.3
933	1.071 811	2 931.106	683 680.5	983	1.017 294	3 088.186	758 921.6
934	1.070 664	2 934.248	685 146.8	984	1.016 260	3 091.327	760 466.5
935	1.069 519	2 937.389	686 614.7	985	1.015 228	3 094.469	762 012.9
936	1.068 376	2 940.531	688 084.2	986	1.014 199	3 097.610	763 561.0
937	1.067 236	2 943.672	689 555.2	987	1.013 171	3 100.752	765 110.5
938	1.066 098	2 946.814	691 027.9	988	1.012 146	3 103.894	766 661.7
939	1.064 963	2 949.956	692 502.1	989	1.011 122	3 107.035	768 214.4
940	1.063 830	2 953.097	693 977.8	990	1.010 101	3 110.177	769 768.7
941	1.062 699	2 956.239	695 455.2	991	1.009 082	3 113.318	771 324 6
942	1.061 571	2 959.380	696 834.1	992	1.008 065	3 116.460	772 882.1
943	1.060 445	2 962.522	698 414.5	993	1.007 049	3 119.602	774 441.1
944	1.059 322	2 965.663	699 896.6	994	1.006 036	3 122.743	776 001.7
945	1.058 201	2 968.805	701 380.2	995	1.005 025	3 125.885	777 563.8
946	1.057 082	2 971.947	702 865.4	996	1.004 016	3 129.026	779 127.5
947	1.055 966	2 975.088	704 352.1	997	1.003 009	3 132.168	780 692.8
948	1.054 852	2 978.230	705 840.5	998	1.002 004	3 135.309	782 259.7
949	1.053 741	2 981.371	707 330.4	999	1.001 001	3 138.451	783 828.2

Note: n may be in any unit of measure, such as in., ft., yards, miles, meters, or fractions thereof.

Example: The diameter of a circle = 933 ft.

Then, the circumference = $933 \times \pi = 2{,}931.106$ ft. (The figure shown opposite 933); and the area = 683,680.5 sq. ft. *Notice* that the decimal point would be moved *the same number of places* to the left in pointing off the circumference, and twice the *number of places* to the left for the area, if the circle was 93.3 ft. in diameter.

The *reciprocal* of a number is simply the quotient of unity (1000 is taken as unity in this table) divided by the number. It is useful in determining decimal equivalents of fractions.

Example: Opposite 960 (above), the reciprocal $\left(\frac{1000}{960}\right) = 1.041667$. Then, the decimal equivalent of the fraction 1/960 in. = 0.001041667 in. And, the decimal equivalent of the fraction 1/96 in. = 0.01041667 in. *Notice* that the decimal point is moved *the same number* of places in the denominators of the two fractions as in the answers, but in opposite directions.

USE NICLOY TUBES for longer service in ALKALINE conditions... ...LOW temperatures

WHEREVER tubing is needed that is highly resistant to severe alkaline corrosion or to low-temperature embrittlement, B&W Nicloy Seamless Tubes can always be depended upon to provide the right answer. Because they have been developed expressly to combat those tube hazards, Nicloy Seamless Tubes give long, satisfactory service life, and at moderate cost. Nicloy Tubes are much more resistant to attack by alkaline media—and have higher impact values at sub-zero temperatures—than do any carbon steels and many of the usual alloy steels.

Nicloy Tubes are especially suited to such applications as these: handling crude oils with substantial salt water and hydrogen sulphide content; handling liquefied gases or other low-temperature fluids in such processes as oil dewaxing; in black liquor recovery units and evaporators of pulp and paper mills; for caustic solution evaporation and alkaline-phenol solution work.

Nicloy Tubing can be readily rolled-in, expanded, or flared and can be produced to standard dimensional tolerances. Investigate the advantages of Nicloy Tubing and let the B&W Research Staff help you apply Nicloy's superior service characteristics to your tough tube jobs. Write for detailed B&W Tube Specifications.

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Ultimate Strength	60000 psi
Yield Strength	30000 psi
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HOURLY COEFFICIENTS OF ORIFICES

Critical Flow Formula:

$Q = CP_u/2$ when the down-stream pressure (P_d) is less than ½ of the up-stream pressure (P_u).

Non-Critical Flow Formula:

$Q = C\sqrt{Pd\ (P_u - P_d)}$ when the down-stream pressure (P_d) is greater than 50% and less than 80% of the up-stream pressure (P_u).

EXAMPLE

Required: The size of orifice that would supply a flow of 200,000 cu. ft. of natural gas per day.

Given: 1400 lb per sq. in. up-stream pressure.
1100 lb. per sq. in. down-stream pressure.

Solution: Use $Q = C\sqrt{P_d\ (P_u - P_d)}$ (for non-critical flow).

Substituting: $\frac{200{,}000}{24} = C\sqrt{1100\ (1400 - 1100)}$

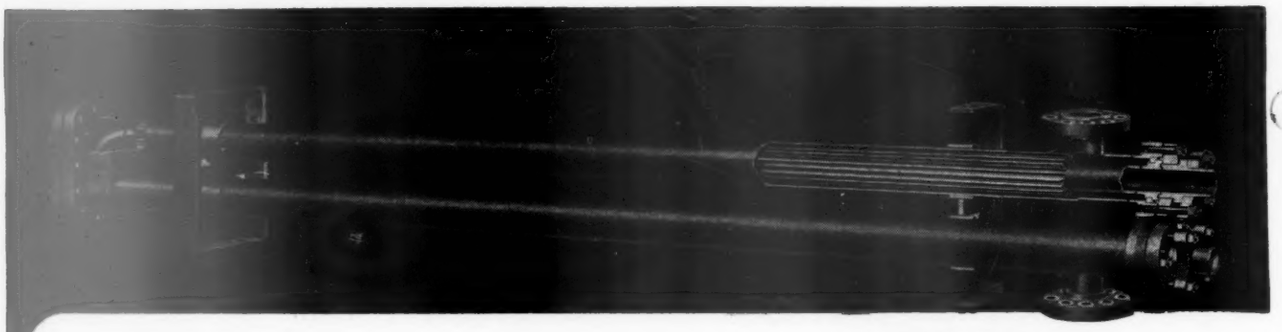
$8333 = C\sqrt{330{,}000}$

$C = \frac{8333}{574.5} = 14.50$ (the hourly coefficient desired)

Then, for a 14.50 coefficient, the bean size would be between 5/64 and 6/64 in. One would provide a little less and the other a little more than desired.

Orifice diameter, in.		Orifice area, sq. in.	Hourly coefficient	Orifice diameter, in.		Orifice area, sq. in.	Hourly coefficient
Fraction	Decimal			Fraction	Decimal		
1/64	0.0156	0.00019		33/64	0.5156	0.20881	570.0
2/64	0.0312	0.00076		34/64	0.5312	0.22162	605.0
3/64	0.0469	0.00173		35/64	0.5469	0.23491	640.0
4/64	0.0625	0.00306	7.26	36/64	0.5625	0.2485	670.0
5/64	0.0781	0.00491	11.22	37/64	0.5781	0.26248	710.0
6/64	0.0937	0.00691	16.25	38/64	0.5937	0.27683	755.0
7/64	0.1094	0.00940	22.0	39/64	0.6094	0.29167	790.0
8/64	0.125	0.01227	29.0	40/64	0.625	0.31464	834.0
9/64	0.1406	0.015526	37.5	41/64	0.6406	0.3223	877.0
10/64	0.1562	0.01966	47.5	42/64	0.6562	0.33819	925.0
11/64	0.1719	0.023208	56.0	43/64	0.6719	0.35456	975.0
12/64	0.1875	0.02765	67.0	44/64	0.6875	0.37122	1010.0
13/64	0.2031	0.03239	81.0	45/64	0.7031	0.39126	1065.0
14/64	0.2187	0.03756	94.0	46/64	0.7187	0.40568	1100.0
15/64	0.2344	0.04315	108.0	47/64	0.7344	0.4236	1160.0
16/64	0.25	0.04908	123.0	48/64	0.75	0.44178	1211.0
17/64	0.2656	0.0554	138.0	49/64	0.7656	0.4682	
18/64	0.2812	0.06215	155.0	50/64	0.7812	0.48020	
19/64	0.2969	0.06923	177.0	51/64	0.7969	0.498768	
20/64	0.3125	0.07866	195.0	52/64	0.8125	0.51848	
21/64	0.3281	0.08454	209.0	53/64	0.8281	0.53858	
22/64	0.3437	0.09278	225.0	54/64	0.8437	0.55907	
23/64	0.3594	0.10144	255.0	55/64	0.8594	0.58007	
24/64	0.375	0.1106	285.0	56/64	0.875	0.60132	
25/64	0.3906	0.11982	317.0	57/64	0.8906	0.62295	
26/64	0.4062	0.12949	338.0	58/64	0.9062	0.64497	
27/64	0.4219	0.1398	374.0	59/64	0.9219	0.66751	
28/64	0.4375	0.15033	405.0	60/64	0.9375	0.69029	
29/64	0.4531	0.16124	426.0	61/64	0.9531	0.71345	
30/64	0.4687	0.17253	456.0	62/64	0.9687	0.73700	
31/64	0.4844	0.18428	490.0	63/64	0.9844	0.76108	
32/64	0.50	0.19635	523.0	64/64	1.00	0.7854	

—Table by Courtesy of Otis Pressure Control, Inc.



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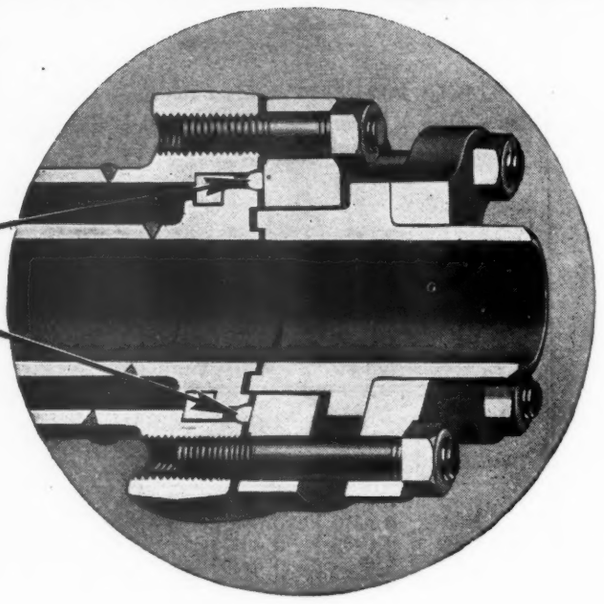

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Enthusiastically endorsed by operating and maintenance departments of oil refineries and chemical processing plants, the ring joint seal is but one of the many exclusive features only Brown Fintube Sectional Heat Exchangers can give you. Brown's exclusive "one-piece" fintubes whose high heat transfer efficiency is maintained undiminished during the entire life of the tube, —our exclusive non-removable rear end construction, and replaceable stud bolting throughout, are some of the others.

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MANUFACTURERS OF BROWN RESISTANCE WELDED INTEGRALLY BONDED ONE-PIECE FINTUBES, AND FINTUBE HEAT TRANSFER PRODUCTS

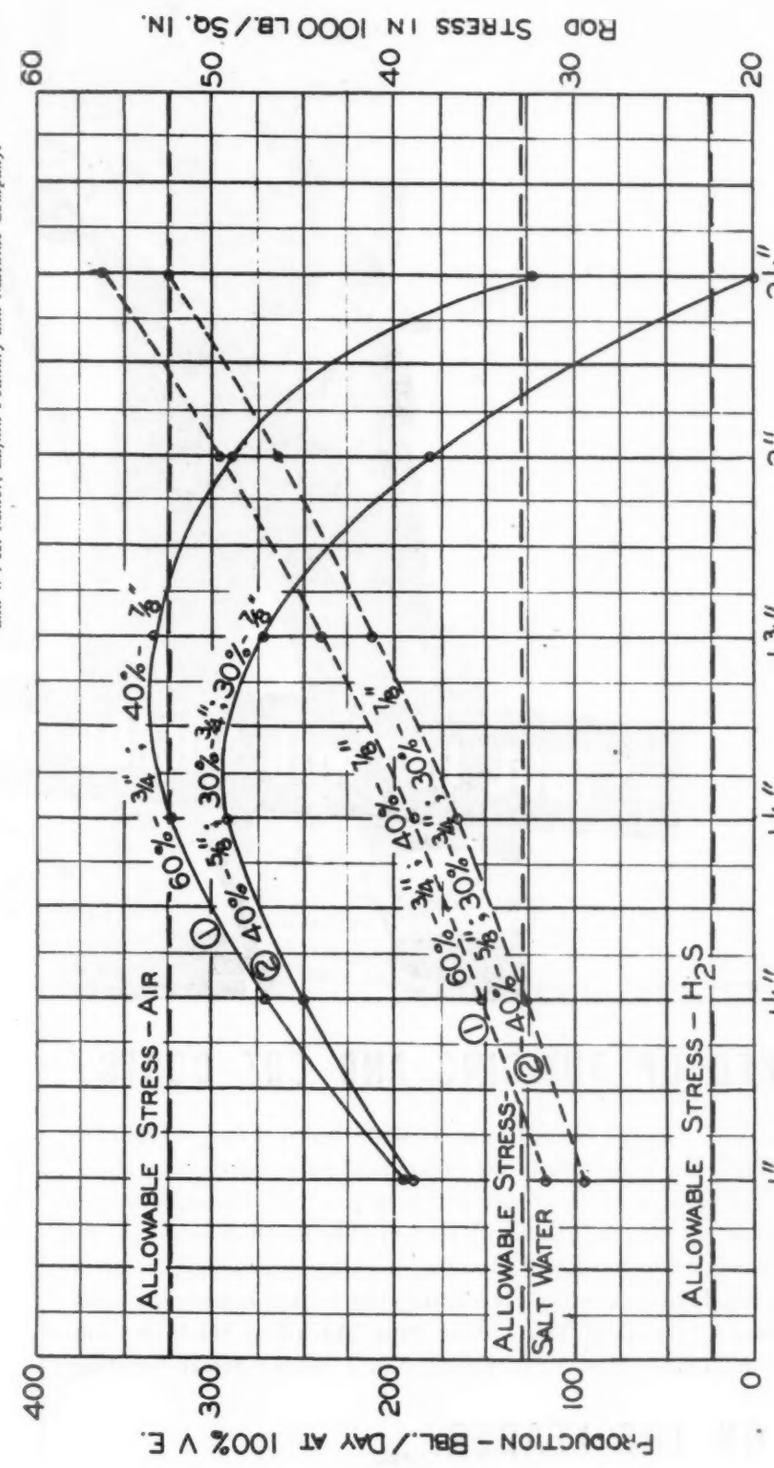
PLUNGER AND ROD SIZE SELECTION CHARTS FOR DEEP WELLS

This series of plunger and rod size selection charts have been designed to illustrate roughly the load and plunger travel conditions that should be anticipated in pumping deep wells. Mills' formula was used in calculating the polished rod load, and Sloneger's formula was used in calculating peak torque. The production of the pumps has been corrected for sucker rod stretch, but not for volumetric efficiency. The specific gravity of the fluid pumped is assumed to be 1.00. The "allowable stress" is necessarily an arbitrary endurance limit, and, if exceeded, an unduly high number of rod failures may be anticipated.

Solid lines are the production curves, and the dashed lines are the rod stress curves for the various combination rod strings.

Conditions for Curve No. 2 (below):
Pumping depth, 7000 ft.
Strokes per min., 20.
Length of stroke, 74 in.
Size of tubing, 2½ in.
Peak polished rod load = 0.6 × rod stress (curves 1 and 2).

—Chart by H. E. Berg, Petroleum Engineer, Tide Water Associated Oil Company, and W. H. Minor, Lufkin Foundry and Machine Company.



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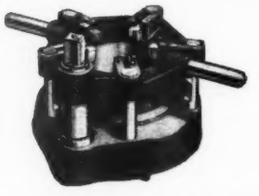
These Toledo-engineered tools will help you do a better, faster job of pipe threading—and reduce costs! Preferred by the man on the job for practical features that mean *easy-threading, accurate, dependable operation.* Backed by nearly half a century's leadership in building better pipe tools. Always specify TOLEDO! The Toledo Pipe Threading Machine Company, Toledo, Ohio. New York Office, No. 2 Rector Street Building.



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PLUNGER AND ROD SIZE SELECTION CHARTS FOR DEEP WELLS

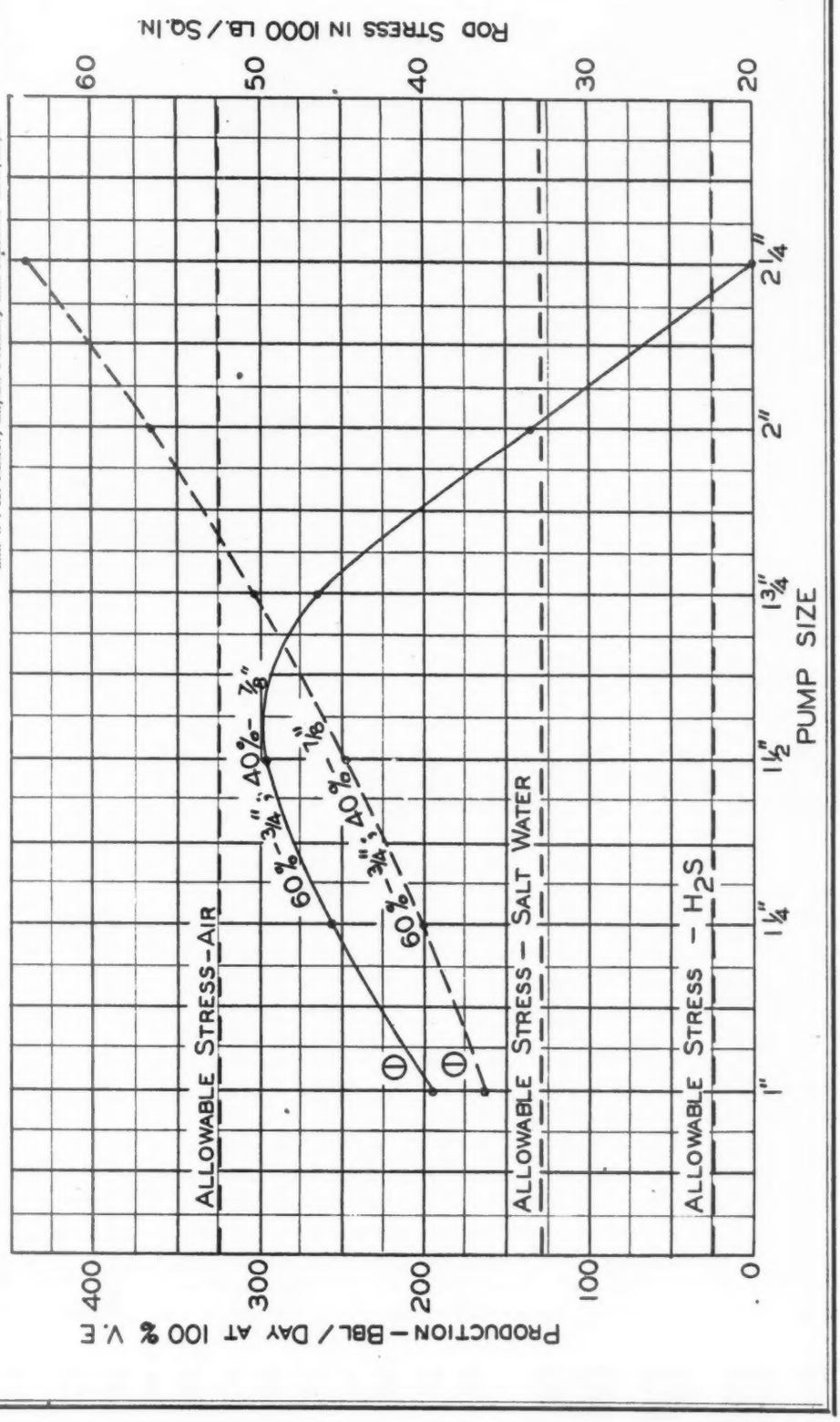
This series of plunger and rod size selection charts have been designed to illustrate roughly the load and plunger travel conditions that should be anticipated in pumping deep wells. Mills' formula was used in calculating the polished rod load, and Sloneger's formula was used in calculating peak torque. The production of the pumps has been corrected for sucker rod stretch, but not for volumetric efficiency. The specific gravity of the fluid pumped is assumed to be 1.00. The "allowable stress" is necessarily an arbitrary endurance limit, and, if exceeded, an unduly high number of rod failures may be anticipated.

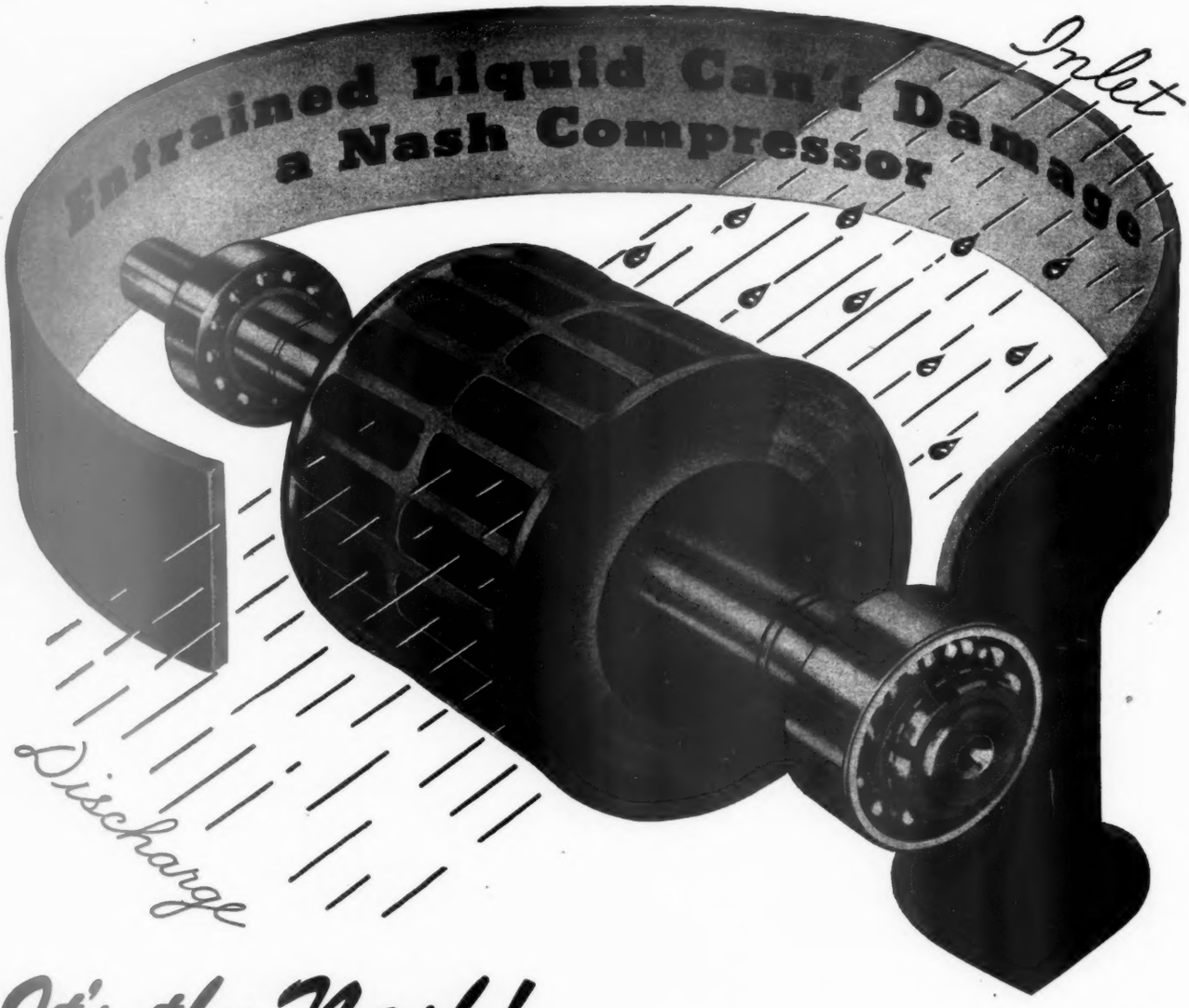
The solid line is the production curve, and the dashed line is the rod stress curve for the combination rod string shown.

Conditions for Curve No. 3 (below):

Pumping depth, 8000 ft.
Strokes per min., 20.
Length of stroke, 74 in.
Size of tubing, 2½ in.
Peak polished rod load = 0.6 × rod stress shown.

—Chart by H. E. Berg, Petroleum Engineer, Tide Water Associated Oil Company, and W. H. Minor, Lufkin Foundry and Machine Company.





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The ability of Nash Compressors to maintain original performance thruout a long life is only one of the many advantages which derive from the Nash liquid piston principle of compression.

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Nash Compressors produce 75 lbs. pressure, or vacuums to 26 in. of mercury, in a single stage. with capacities to 6 million cubic feet per day in a single structure. They have but one internal moving part, simple and non-wearing. There are no valves, gears, pistons, sliding vanes, or other enemies of long life. No gas contaminating internal lubricant is employed. Compression is without pulsation. It will be to your advantage to investigate the Nash Compressor.

26 in. mercury vacuum or 75 lbs. pressure in one stage.

No internal wearing parts.

No internal lubrication to contaminate gas handled.

Desired delivery temperature automatically maintained.

Non-pulsating pressure.

Original performance corstant over a long pump life.

Low maintenance cost.

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Running Tour WITH MEN IN THE INDUSTRY

• **John L. Miller,** superintendent of operations at Shell Oil Company's Deer Park Refinery, has just returned to his former job at Shell after 44 months of continuous service outside the country. Miller has 26 years of accumulated service with the Shell organization, having started as a gauger at the Wood River, Illinois, refinery in 1920. He worked up through the ranks of the company's manufacturing department, being made successively assistant head stillman, assistant superintendent, and superintendent at other Shell refineries until he was transferred to Houston in 1937. In March, 1942, he was commissioned a major and sent to Melbourne, Australia.

John L. Miller

P. E. Hurley, who acted as superintendent during Miller's absence, is now manager of the company's Norco, Louisiana, refinery.

• **W. D. Ligon** has been appointed works manager of the new Buffalo plant for Westinghouse Electric Corporation. During the time necessary to completely shift the division's operations from Pennsylvania, Ligon will act as resident manager of the Buffalo plant.

• **R. C. Brown** has been appointed assistant to manager, Denver region, production and drilling department, Continental Oil Company. In this new position Brown will act as assistant to **J. C. Johnston,** regional manager. Brown has been with the Continental organization since 1924.

• **Guy S. Burson** has been named Tulsa land representative for Continental Oil Company, succeeding **George F. Burgher,** who has returned to independent leasing operations. Burson will have headquarters in the Philtower Building, Tulsa.

• **J. J. King,** formerly with The Texas Company, is now assistant superintendent of compressor stations for Tennessee Gas and Transmission Company, Houston, Texas.

• **E. G. Price** has been appointed general superintendent of National Works, National Tube Company, at McKeesport, Pennsylvania, it has been announced by E. N. Sanders, vice president in charge of operations of this United States Steel subsidiary.

• **Perry A. Gill,** recently returned from the Army, is now division engineer for Sunray Oil Corporation at Fort Worth, Texas. Gill was with Cities Service at Oklahoma City prior to entering the army in July, 1942. **J. F. Adkisson,** formerly of Fort Worth, is to be in charge of secondary recovery for Sunray at Tulsa. **Bud Harder** has left Cities Service at Oklahoma City to become assistant general superintendent of production for Sunray at Tulsa.

• **William D. Goold** has been appointed assistant superintendent of the production department in the San Joaquin Valley for the Tide Water Associated Oil Company, replacing **F. M. Watkins** who recently passed away. Goold entered the employ of Tide Water Associated 18 years ago and has served as a floorman on a drilling derrick, petroleum engineer, production engineer, and district production engineer in the Ventura district. **Frank H. Kratka, Jr.,** has been appointed district production engineer at Ventura to succeed Goold. He entered the company's employ 6 years ago, beginning as a roustabout and advancing through the positions of draftsmen, rotary helper, wellman, production engineer, and acting district production engineer to his present position. **Thomas E. Weaver** was appointed to succeed Kratka as district production engineer in the San Joaquin Valley. He joined Tide Water Associated in 1941 and has served as a roustabout, wellman, and production engineer. **William E. Perkes** has been appointed district petroleum engineer in the Los Angeles Basin. Perkes started with Tide Water Associated in 1937 as a draftsman, later advancing to the position of assistant office engineer and petroleum engineer.

• **Gordon Loud** has been appointed Middle East representative for The Atlantic Refining Company, with headquarters in Cairo, Egypt. Loud, an archeologist of many years experience, was recently released by the Office of Strategic Services in Washington where he served in a civilian capacity during the war.

• **Donald Lincoln,** of St. Davids, Pennsylvania, has been appointed manager of the refinery supply and distribution division of Sun Oil Company. Lincoln was formerly manager of the refinery production control division. He joined Sun Oil in 1930. The appointment of **Clifford Johnson,** of Claymont, Delaware, as assistant superintendent of the company's Marcus Hook (Pennsylvania) Refinery in charge of maintenance and construction has also been announced. Johnson, formerly superintendent of maintenance, succeeds **Alan T. Knight** who was elected vice president of Catalytic Engineering Construction Company, recently organized to engage in the design and construction of oil refineries and oil refinery equipment. **John E. Lilley,** of Secane, Pennsylvania, formerly project engineer, has been appointed chief construction engineer of the Marcus Hook Refinery, and **Vaughn S. Whitesell,** of Wilmington, Delaware, formerly maintenance engineer, has been appointed chief maintenance engineer. **Howard B. Sheppard,** of Chester, Pennsylvania, has been promoted to project engineer in the manufacturing department at 1608 Walnut Street, Philadelphia. **A. Cyril Daldy,** former assistant director of foreign refining, PAW, has joined the public relations staff of Sun Oil Company. **G. M. Parker,** office manager of the company's Montreal district office, has returned from military service and will resume his former duties. **R. H. Aitken,** who served as office manager at Montreal, is being transferred to the Philadelphia office.

Donald Lincoln

Clifford Johnson

• **D. F. Benton,** manager of the Rocky Mountain sales division of Standard Oil Company (Indiana), was promoted April 1 to assistant general manager for the Rocky Mountain division with headquarter at Denver, Colorado. **W. B. Egbert,** assistant manager at Mason City, Iowa, will be promoted at the same time to manager of the Denver sales field. **E. A. Tessien,** assistant manager at Billings, Montana, will succeed Egbert, and **A. G. Martin,** sales manager at Wichita, Kansas, will succeed Tessien.

• **Robert Cheney Hart** died in London, England, March 30. He was formerly British vice consul in Ciudad Bolivar and for many years had been an operator in the Venezuelan oilfields, where he was president of the United Venezuelan Oil Company, Ltd. He was also interested in other Venezuelan properties throughout the republic. As far back as 1910, Hart was one of the pioneers in the Mexican oilfields. Prior to World War II he drilled several wells in the North Texas area.

• **Don Campbell** has been appointed to the public relations staff of the American Locomotive Company. Campbell was recently placed on inactive status after service as a senior lieutenant in the Pacific with the United States Navy.

• **E. W. Beck,** manager of purchases for General Petroleum Corporation, has been appointed assistant purchasing agent for the Socony-Vacuum Oil Company, Inc., New York, General's parent company. Beck has been with General Petroleum since 1923.

Paul J. Whitley succeeds Beck as manager of purchases for General Petroleum, moving up from the position of assistant manager he has held since 1937. **James Ross,** a real veteran of General Petroleum, having been with the company since 1915, succeeds Whitley as assistant manager of purchases.

• **R. K. Baker** has resumed his duties in the Petroleum Rectifying Company construction department at Long Beach, California. Baker served in the U. S. Marine Corps and saw 18 month's service in the Marshall Islands and Marianas campaigns, being wounded at Guam.

• **Donald P. Krotz** has been appointed assistant to the president of the California Research Corporation, Standard of California subsidiary. After graduating from Stanford University as a chemical engineer, he joined Standard at the Richmond Refinery. After 12 years in engineering, maintenance, and distillation operations there, Krotz in 1938 was transferred to Standard's department on organization in the San Francisco home office.

Donald P. Krotz

• **James R. Everett** has rejoined the Petroleum Rectifying Company after 2 years in the U. S. Navy Seabees. Everett is now assigned to the Petreco Machine Shop at Long Beach.

• **Miss Alice C. Bartles** has been named assistant secretary of the Standard Oil Development Company, central research and technical organization of Standard Oil Company (New Jersey). Starting with the Stand-

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The Martin-Decker Clipper Gives Fast Portability . . . Complete Adaptability

The Martin-Decker Clipper is the weight indicator to use for drilling and production operations where maximum portability is desired. Martin-Decker Clipper Weight Indicators are now available in two types. The Tool Pusher type is for use where a permanent record is not desired and minimum rig-up time is of prime importance. The "Sealtite" type is designed for maximum accuracy and service and is available with chart recorders. Factory loaded and permanently sealed, it does away with the necessity for adjusting or priming. Avoid haphazard guesswork by installing a Clipper Weight Indicator and be assured of accurate drilling information at all times.

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ard Oil Company of New Jersey as a typist 13 years ago, Miss Bartles soon was doing secretarial work and since 1943 has been assistant to R. W. Burkart, secretary of the development company.

H. J. Struth

• **H. J. Struth**, Dallas, Texas, economist for the Texas Mid-Continent Oil and Gas Association, has been named a member of the Interstate Oil Compact Commission's enlarged economics advisory committee. This committee includes the nation's top-ranking economists and will keep the Compact Commission advised on economic trends in the oil and gas industries.

• **W. T. Dabbs** has been made district superintendent, and **B. H. C. Stover,** district chief clerk, of Humble Oil and Refining Company's recently established new Hub district headquarters in Columbia, Mississippi. Both were transferred from similar position with Humble at Eucutta district headquarters at Waynesboro, Mississippi. **S. E. Wallette,** formerly farm boss at Humble's Bayou Sale district, Franklin, Louisiana, has been made district superintendent of the Eucutta district, and **J. M. Barber** has been transferred from district chief clerk at Heyser gas plant in the production department's Southwest Texas division to district chief clerk in the Eucutta district. Also Humble's production department has announced the return of 26 men from the armed forces to its supervisory personnel. **S/Sgt. M. U. Bateman,** who entered employment of Humble September 18, 1933, returned to the company as chief clerk at the Heyser gasoline plant February 16 after serving 2 years with the Army. **SKD2/C V. A. Carpenter,** who entered employment of Humble February 13, 1933, returned to the company as assistant chief clerk in the Friendswood district, Gulf Coast division, after serving 2 years in the Navy. **D. D. Dennison,** who entered employment of Humble May 13, 1936, returned to the company's Houston office production accounting department after serving more than 3 years in the Navy. **S/Sgt. W. W. Petty,** who entered employment of Humble June 1, 1936, returned to the company as assistant chief clerk in the Andrews district, West Texas division, after serving more than 3 years in the United States and Pacific theaters. **Lieut.-Col. V. L. Wimberly,** who entered employment of Humble December 9, 1932, has returned to Humble's Katy products line construction district as chief clerk after more than 5 years' service with the Army. **Lieut.-Commander Philip E. Barber, Jr.,** who before entering the Navy was Humble's assistant divisioh civil engineer in the Louisiana division, has returned to

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the company as assistant division civil engineer in the Gulf Coast division. **Captain William B. Burklin,** junior engineer in the East Texas division before entering the Army Air Corps, which he served in the United States and in Europe, has returned to Humble's East Texas division as civil engineer. **Lieut.-Col. William A. Castille,** Humble's office civil engineer in the Louisiana division before entering the Army February 28, 1942, has returned to the same division as assistant division civil engineer. **Major Everett C. Clark** has returned from the Army to the company's Gulf Coast division as civil engineer. **Captain Murray H. Cunningham,** who left the company March 3, 1941, for Army service, is back as Humble's district civil engineer in the Natchez district. **Major O. L. Fontenot,** who was with the company's Gulf Coast division before entering the Army February 26, 1942, is back as senior civil engineer in the West Texas division. **T/5 Nathaniel Ford,** design engineer at Baytown for Humble before entering the Army, is back as a civil engineer in Houston. **Captain F. S. Godbold,** who served in the Army in British West Indies, Trinidad, and Italy, is back with Humble as civil engineer in the Louisiana division. **Captain Andrew M. Gruy,** who was with Humble's Louisiana division before entering the Army, has returned as a civil engineer in the Gulf Coast division. **Major Dudley J. Lewis,** who was a draftsman at Baytown for Humble before entering the Army, has returned to the company as a civil engineer with the production department in Houston. **Major H. E. Lott,** who saw service with the Army in the United States, has returned to Humble as civil engineer in Houston. **Major Eugene H. McCann** has returned to the company as civil engineer in the Southwest Texas division after serving with the Army. **Lieutenant Richard C. Newsome,** civil engineer in the Gulf Coast division before entering the Navy, has returned to the company in the same division as district civil engineer. **Colonel J. U. Parker,** civil engineer for Humble in the North Texas division before entering the Army, has returned to Southwest Texas division after serving for 5 years in the Army. **Lieutenant G. B. Randolph,** civil engineer in the Louisiana division before going into the Navy, has returned to work in the same division as a district civil engineer. **Lieutenant Everett T. Shahan,** after serving in the Navy has returned to Humble as a civil engineer in the East Texas division. **Lieutenant - Colonel Charles M. Sherfesee,** after serving in the Army, has returned to Humble as a civil engineer in the East Texas Division. **Major J. M. Spiller,** in the Louisiana division before entering the Army, has returned as a district civil engineer in the East Texas Division. **Lieutenant-Colonel John S. Toler,** after serving with the Army has returned to Humble as district civil engineer in the Louisiana Division. **Lieutenant-Colonel Wyatt G. Trainer,** after nearly 6 years of service with the Army has returned to Humble as civil engineer in the Southwest Texas division. **Major Lloyd O. Zapp,** civil engineer in the Gulf Coast Division before going into the Army, has returned to Humble as a supervising engineer in Houston.

• **Bryan Patterson** has returned to Hill-Hubbell and Company Division of General Paint Corporation, Cleveland, Ohio, as pipe line corrosion engineer after a 4-year wartime leave of absence.

• **Hugh W. Field** has been elected a director of The Atlantic Refining Company. Field is assistant manager of the company's research and development department.

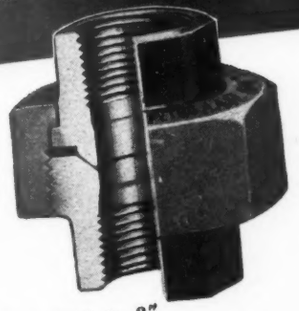
Unions are hot forged from solid round bars of high quality Open Hearth Forging Steel.

Handle-Bar

Hi-Speed Handle-Bar Unions with integral steel to steel seats, or completely fused bronze to bronze seats, black or Udylite (cadmium plated) — sizes from ⅜" to 4" inclusive in 4000 test, sizes 2" to 4" inclusive in 6000 test.

4000 Test Unions furnished with Briggs Standard steam threads in pipe ends, whereas the 6000 Test Union has long pipe ends with API line pipe threads. Nut threads are modified Acme to facilitate easy and speedy assembly and disassembly. Seat design is a 45 degree cone, machined and cold rolled, to a ball seat on male end. Handle-Bar Unions are recommended for all services where they are made up and taken down frequently.

Petro



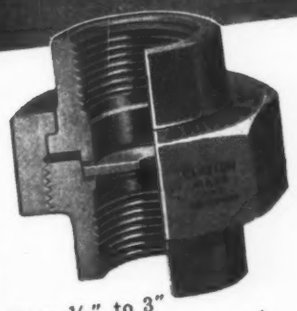
Sizes ⅛" to 3"

PETRO unions have integral steel to steel seats. Made to A. A. R. design. 600 lbs. S. W. P.-2000 lbs. C. W. P. Extra heavy ends and nut with nut threads that are permanently lubricated. The seats are machined and cold rolled.

Pressures from a vacuum to 3000 lbs.: Temperatures from 100° below zero F. to 1000° above zero F.: On Steam, Gas, Air, Oil, Gasoline, Ammonia, Chemicals, and any service in which Steel or Wrought Iron Pipe is used.

Orifice

Ideal for flow control of Steam, Oil, Ammonia, Water, Gas or Air. Also for metering and measuring. 600 lbs. S. W. P. or 2000 lbs. C. W. P. The ORIFICE plate is furnished in cold rolled 18-8 stainless steel. ORIFICE plate and gaskets are set in a groove of solid steel to safeguard against blowing of gaskets and resultant trouble. The ORIFICE union has extra heavy ends and nut with the nut threads permanently lubricated.



Sizes ¼" to 3"

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ORIGINATORS AND PIONEERS OF FORGED STEEL UNIONS SINCE 1912

CLAYTON MARK & COMPANY

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WELL LOGGING METHODS STUDIED AT TEXAS A&M

By **HUBERT GUYOD,** *Well Logging Consultant*

A REFRESHER course in well logging comprising conferences, round table discussions and field demonstrations was given March 11 to 15 by the Petroleum Engineering Department of the A. and M. College of Texas. Although intended primarily for returned service men and regular students, more than 170 oil industry representatives attended.

EXCLUSIVE

The course was planned by Harold Vance, head of the Petroleum Engineering Department, and his assistant, Professor A. B. Stevens. The writer led the conferences.

Twelve lectures were delivered. Each was followed by a discussion. The program gives the subjects and speakers included in this symposium.

(1) Well Logging Problem, Hubert Guyod, consultant.

(2) Radioactivity Logging (conference and field demonstration), John L. P. Campbell, Lane-Wells Company.

(3) Electrical Logging Fundamentals, Hubert Guyod.

(4) Permeability Logging, Lester Swan, Dowell Incorporated.

(5) Geochemical Logging, Leo Horvitz, Horvitz Research Laboratories.

(6) Caliper Logging (conference and field demonstration), H. C. Waters, Halliburton Oil Well Cementing Company.

(7) Mechanical Logging, P. B. Nichols, Cities Service Oil Company.

Felix Mendoza, Minister of Mines and Petroleum, a guest from Colombia, Hubert Guyod, and Harold Vance, head of petroleum engineering department, Texas A. and M. College.

WELL LOGGING METHODS

Method	Type	Properties investigated	Use
Acoustic	Sound intensity	Cohesion	0
	Sound velocity	Elasticity, density	0
Chemical	Insoluble residues of samples	Mineral content	1
	Hydrocarbon content of samples	Petroleum content	2
	Gas detection in mud	Gas content	2
Electric	Natural potential	Electrochemical properties	1
	Secondary potential	Electrochemical properties	3
	Formation conductivity	Water content, Texture	3
	Mud conductivity	Salt water content	1
	High frequency response	Dielectric constant, Conductivity	0
	Polarization	Electrochemical properties, Dieletric constant	0
	Transients	Miscellaneous properties	0
Gravitational	Gravity	Density	0
Intake	Capacity	Permeability	2
Magnetic	Susceptibility	Effect of terrestrial field	0
	Retentivity	Effect of artificial field	0
	Retentivity decay	Coercive force	0
Mechanical	Hole calipering	Brittleness, Solubility	3
	Drilling rate	Hardness, Compactness	2
	Drilling reaction	Hardness, Compactness	0
Optical	Examination of formations	Color, Texture	0
	Examination of samples	Color, Texture, Content	3
	Fluorescence of formations	Oil content	0
	Fluorescence of mud	Oil content	2
Radioactive	Natural radioactivity	Radioactive substance content	3
	Artificial radioactivity	Hydrogen content	2
Seismic	Wave velocity	Elasticity, Density	0
Thermal	Gradient	Thermal Conductivity, Gas expansion	1
	Transitional	Brittleness, Solubility	1

Legent: 0 not used; 1 little used; 2 frequently used; 3 extensively used.

(8) Mud Logging, B. Otto Pixler, Baroid Sales Division.

(9) Dip Determination, E. F. Stratton, Schlumberger Well Surveying Company.

(10) Electric Log Interpretation, Hubert Guyod.

(11) Temperature Logging, Hubert Guyod.

(12) Concluding talk, Hubert Guyod.

The course began with an address by Gibb Gilchrist, A. and M. president, and an outline of the program by Professor Harold Vance. The first lecture brought out the fact that about 8 billion dollars have been spent in drilling in the U. S. during the last 10 years, and that this large investment has benefited economically by many technological developments, particularly by the extensive use of improved well logging methods. Although more than 30 different well logging methods are known at present, only a few are used extensively (see table).

● **Radioactivity logging.** The properties of gamma ray logs and neutron logs were explained by J. L. P. Campbell. The gamma ray curve is a measure of the natural gamma ray radiation from the formations. The neutron curve is obtained by measuring the effect of bombarding the formations with a strong neutron source. Depending upon the problem, the curves may be obtained alone or in combination by making two runs. The gamma ray curve is a lithologic log of the various formations, penetrated by the well, and the neutron log is a measure of the relative hydrogen content in the formations.

Inasmuch as both oil and water contain hydrogen, the neutron curve is very helpful for the location of porous formations, especially when used in conjunction with the gamma ray log. Radioactivity logs, however, do not distinguish oil from water. Inasmuch as the nature of the well fluid or amount of casing have no detrimental effect on the interpretation of the radioactivity data, logs can be obtained under well conditions that prohibit obtaining electrical logs.

● **Electrical logging.** The first lecture was primarily a review of the fundamentals of the method.

The second lecture dealt with the interpretation of electric logs. Using numerous examples, the fundamental difference between apparent resistivity, i.e. the value read on the log, and true resistivity were pointed out. A method for estimating true resistivity from the apparent values was then explained.

● **Permeability logging.** Permeability logging, as explained by Lester Swan, is carried out with a relatively new instrument that is used to determine the position, thickness, and relative capacity of the various permeable zones in a well by locating the interface between 2 immiscible liquids of different conductivity, such as oil and water or oil and acid. By introducing oil at a constant rate into the well above the other liquid, the latter is forced into the formation at a rate that can be determined from the position of the interface. ★★★

Lane-Wells GUN PERFORATOR Gives You Complete BULLET SELECTIVITY

Experience proves that no single type of drilling bit is ideal for every formation. Lane-Wells research and testing has proved that no single type of bullet is ideal for every gun perforating requirement.

Lane-Wells has tested seventy different bullet designs to learn which types are best for particular usage. The table below illustrates the six standard types of bullets which Lane-Wells makes available to the industry.

On your next job—call in the Lane-Wells representative and discuss with him the selection of the bullet to get the best results.

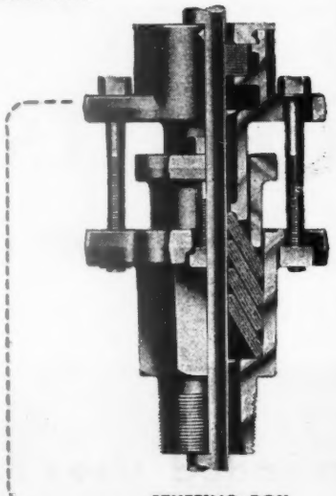
(Read the series of articles now appearing in "Tomorrow's Tools—Today!")

LANE WELLS COMPANY

35 BRANCHES • 24 HOUR SERVICE

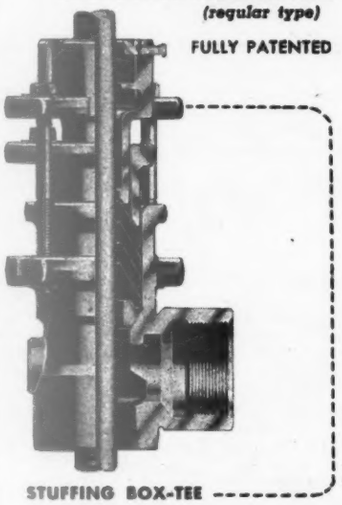
"CONE PACKING" CAN STAND THE GAFF

When the going is toughest, Operators turn to Hercules . . . it has been tested and accepted in every oil producing field as Standard. Hercules "Cone Packing" has successfully withstood over 2000 pounds pressure . . . has cut packing costs 75% and more in many instances . . . eliminates wabblers . . . is automatically lubricated . . . won't burn out if well pumps off . . . protects polish rod against excessive wear . . . is easy to install and is moderate in price. Next time . . . "Ask for the Cone Packed Box."



STUFFING BOX
(regular type)

FULLY PATENTED



STUFFING BOX-TEE
(T-base type)

Sold at all supply stores.

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HERCULES
TOOL COMPANY

TULSA, OKLAHOMA, Box 286
EXPORT OFFICE: 30 Rockefeller Plaza
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CABLE ADDRESS: HERTOCO

LAUGH WITH BARNEY

Upon inviting a friend to his wedding anniversary an Irishman explained: "We are on the 3rd floor, apartment D. Just touch the door button with your elbow."

"And why should I use my elbow?"

"Well, for heaven's sake, you aren't coming empty handed, are you?"

Have you heard the one about the little anemic runt who goes up to a bar and orders two martinis from a big, muscular bartender? He drinks one and dumps the other in his vest pocket. The process is repeated six times. Finally the huge bartender says to the runt, "What's the idea of dumping those drinks in your vest pocket?" "Shut up and mind your business or I'll knock your block off," says the runt. With that a little mouse with bloodshot eyes pokes his head out of the vest pocket and says, "And that goes for your — — cat, too!"

"Did you get home all right last night, sir?" asked the street car conductor of one of his regular passengers.

"Of course. Why do you ask?"

"Well, when you got up and gave the lady your seat last night, you were the only two people on the car."

Elderly lady lunching in cafe: This rhubarb seems very stringy.

Waiter (politely): Have you tried eating it with your veil up?

Friend: I'm going to see the doctor about my wife. I don't like the way she looks.

The other one: I'll go along with you. I don't like the looks of mine, either.

Steward: How would you like your breakfast, sir?

Passenger: With an anchor on it, if you don't mind.

She: Oh, Carl, there was once a time when you used to stroke my chin so lovingly. You don't do it any more."

He: Yes; but that was when you had only one.

Blonde: I suppose you've been in the Navy so long that you're accustomed to sea legs.

Sailor: Why, lady, I wasn't even looking.

Hospital Visitor: I just heard those two nurses saying some mean things about you.

Patient: Yeah, they've had me on the pan ever since I got here.

Dear Old Lady: Little boy, does your mother know that you smoke?

Junior: Listen, lady, does your husband know you speak to strange men on the street?

The salesman whose pants wear out before his shoes is making too many contacts in the wrong places.

My brother says his girl friend is so dumb she doesn't know whether lettuce is a vegetable or a proposition.

Many a woman thinks she bought a gown for a ridiculous price when in reality she bought it for an absurd figure.

"Hello, is this the Fidelity Insurance Company?"

"Yes, madam."

"Well, I would like to arrange to have my husband's fidelity insured."

Nowadays when you see someone in pants walking ahead, you don't know whether it's a girl or a man with a grapefruit in each hip pocket.

POPULAR YOUNG COUPLE MARRIED THIS WEEK

(From the Society Page of an Anonymous Newspaper)

Mr. Robert Chetway and Miss Alice Broadkin were married at noon Monday at the home of the bride's parents, Mr. and Mrs. P. D. Broadkin, Rev. M. L. Cassoway officiating.

The groom is a popular young bum who hasn't done a lick of work since he got shipped in the middle of his junior year at college. He manages to dress well and keep a supply of spending money because his dad is a soft-hearted old fool who takes up his bad checks instead of letting him go to jail where he belongs.

The bride is a skinny, fast little idiot who has been kissed and handled by every boy in town since she was 12 years old. She paints like a Sioux Indian, sucks cigarettes in secret, and drinks mean corn liquor when she is out joyriding in her dad's car at night. She doesn't know how to cook, sew or keep house.

The house was newly plastered for the wedding and the exterior newly painted, thus appropriately carrying out the decorative scheme for the groom was newly plastered, also, and the bride newly painted.

The groom wore a rented dinner suit over athletic underwear of imitation silk. His pants were held up by pale green suspenders. His number eight patent leather shoes matched his state in tightness and harmonized nicely with the axle-grease polish of his hair. In addition to his jag he carried a pocket knife, a bunch of keys, a dun for the ring, and his usual look of imbecility.

The bride wore some kind of white thing that left most of her legs sticking out at one end and her bony upper end sticking out at the other.

The young people will make their home with the bride's parents, which means they will sponge on the old man until he dies and then she will take in washing.

Postscript: This may be the last issue of the *Tribune*, but my life's ambition has been to write up one wedding and tell the unvarnished truth. Now that it is done, death can have no sting.

A clergyman was being shaved by a barber who had evidently become unnerved by a previous night's dissipation. Finally he cut the clergyman's chin. The latter looked up at the barber reproachfully and said:

"You see, my good man, what comes of hard drinking?"

"Yes, sir," the barber replied consolingly, "it sure makes the skin tender, don't it?"

Two Wacs were being followed by a soldier. Finally one became indignant and, turning to the soldier, said:

"Either quit following us or go and get a friend."

In civilian air circles a "short" is a non-priority passenger. If possible, when removed from a flight he is given what is known as "protection," i.e., hotel facilities or other transportation. A new American Airlines stewardess, unfamiliar with this jargon, was startled to receive this radiogram in midair:

"Prepare to remove shorts at Detroit."

IT'S TOPS

FOR SECURING A GOOD "FIRST-TIME" CEMENT JOB IN EVERY WELL

Oil men refer to the BAKER CEMENT WASH-DOWN WHIRLER FLOAT SHOE Product No. 120 as the "best all around shoe for floating and cementing casing in a well."

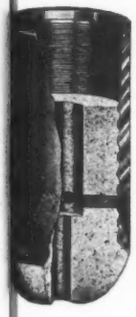
There are other units of BAKER CEMENT EQUIPMENT to meet ALL your cementing needs.

The BAKER CEMENT Float Collar

Positioned one or two joints from bottom, it serves as a float valve; also as a stop for the cementing plug, thus retaining cement tailings inside the casing. It is run with a regular Guide Shoe, or a Whirler Guide Shoe in wells of average depth. In deeper wells it is good practice to use this Baker Float Collar with a Baker Cement Wash-Down Whirler Float Shoe.

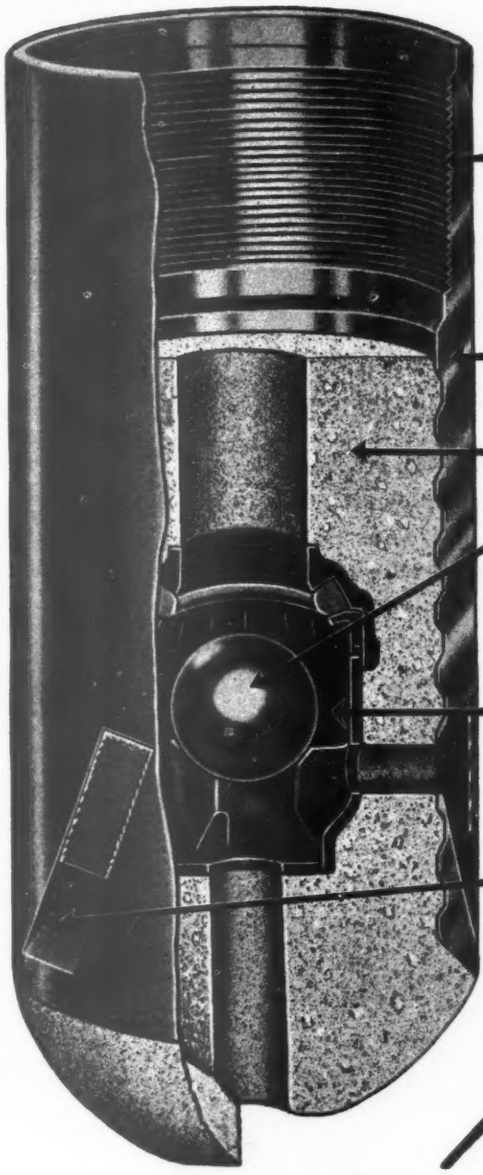
The BAKER CEMENT Guide Casing Shoe

Generally used with a Baker Cement Float Collar. In wells of average depth, this Shoe is amply strong to guide the longest string of casing safely to bottom. The rounded nose readily passes any side wall irregularities. The plug of Baker-Formula Concrete is easily drilled up and circulated out of the hole.



The BAKER CEMENT Wash-Down Whirler Guide Shoe

Where bridges, or other formation obstructions are likely to be encountered, this Guide Shoe is used in combination with a Baker Cement Float Collar (above). The Wash-Down Whirler Guide Shoe then safely guides the casing past any wall irregularities, washing the side walls, breaking down bridges, and preparing the hole for a good cement job. When cementing is commenced the Guide Shoe whirls the slurry to uniformly encase the pipe.



THEY ARE CORRECT for no other shoe has these 7 points of superiority, which total up to "BEST" . . .

1. Accurate threads to fit the specifications of *your* casing;
2. A seamless steel shoe in which a concrete plug and plastic ball-type valve assembly are so securely anchored that it has strength—and to spare—for floating the longest, heaviest string of casing;
3. Easy drillability and disposal of plastic and Baker-Formula Concrete;
4. A plastic ball which floats in cement slurry, and instantly seals against a recessed rubber ring if slightest back-pressure develops;
5. Ample circulating areas for *any* cementing or circulating operation;
6. Wash-down whirler ports which (a) direct the fluid to prepare the hole; and (b) whirl the cement slurry around the shoe and shoe joint to uniformly encase the pipe, and prevent channeling;
7. The mark—BAKER—the unquestioned symbol of "tops" in equipment for floating, landing and cementing casing.

BAKER CEMENT Guiding, Floating and Cementing EQUIPMENT

Be prepared to perform a successful, "first-time" cement job in your next well. You will find complete details on BAKER CEMENT EQUIPMENT in the 1944 Composite (or Baker) Catalog; or TELEPHONE ANY OF THESE BAKER SERVICE LOCATIONS . . .

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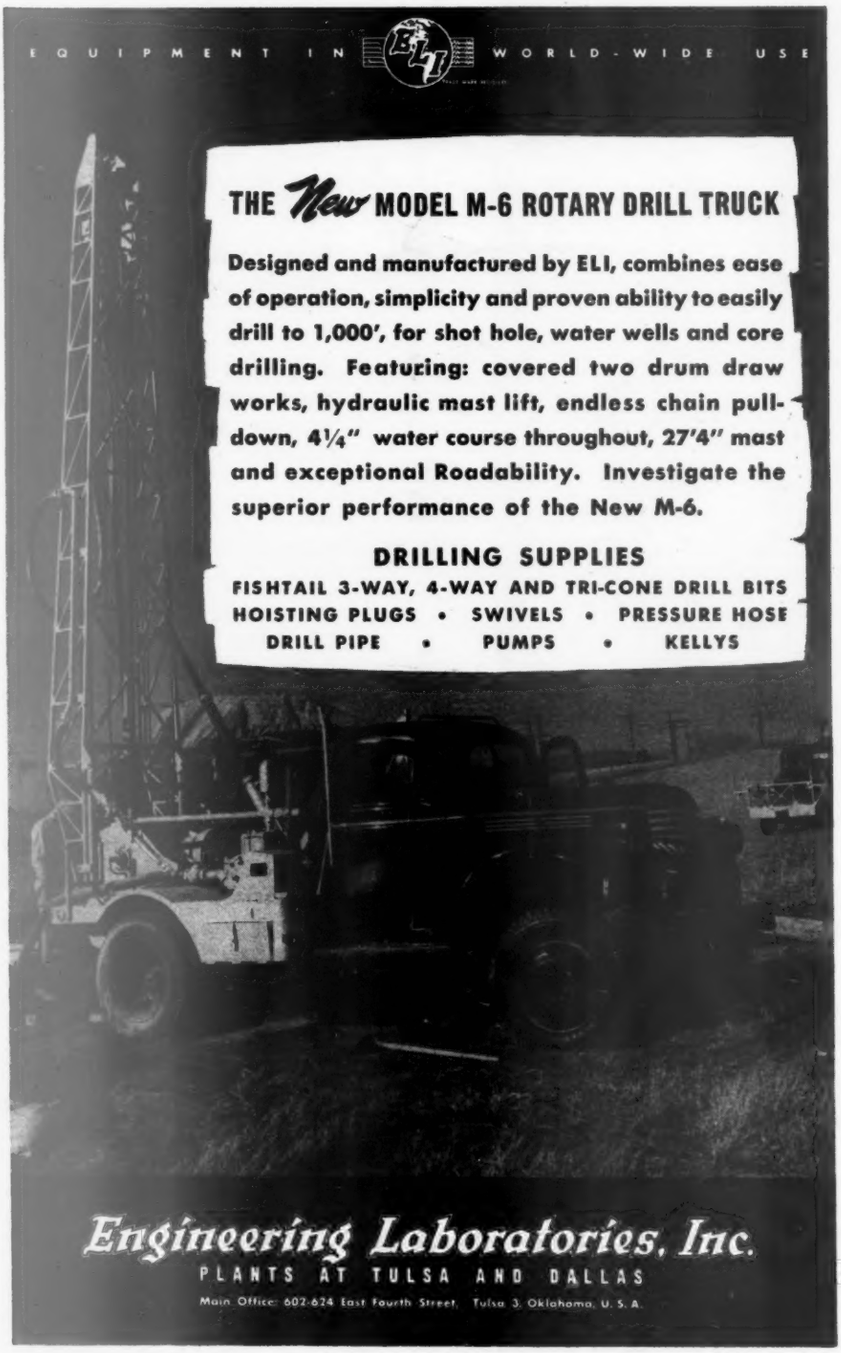
Officers of the Western Petroleum Refiners Association pause briefly for a group picture during the busy three-day session of technical and business meetings comprising the 34th annual meeting at Fort Worth, Texas, beginning March 25. Front row, left to right; J. W. Vaiden, Skelly Oil Company; T. H. Helling, El Dorado Refining Company; H. T. Ashton, Socony-Vacuum Oil Company; R. W. McDowell, Mid-Continent Petroleum Corporation; Fayette B. Dow, National Petroleum Association; F. H. Dunn, Wilcox Oil Company; Raymond L. Tollett, Cosden Petroleum Corporation; R. R. Irwin, Socony-Vacuum Oil Company. Back row, left to right: W. F. Sims, Panhandle Refining Company; J. W. Warner, Tide Water Associated Oil Company; C. L. Henderson, Vickers Petroleum Company; R. E. Luton, The Ohio Oil Company; O. L. Cordell, Bareco Oil Company; Roland V. Rodman, The Bay Petroleum Corporation; W. W. Vandeveer, Allied Oil Company, Inc.; Reid Brazell, Leonard Refineries, Inc.


EQUIPMENT IN ELI WORLD-WIDE USE
THE New MODEL M-6 ROTARY DRILL TRUCK
Designed and manufactured by ELI, combines ease of operation, simplicity and proven ability to easily drill to 1,000', for shot hole, water wells and core drilling. Featuring: covered two drum draw works, hydraulic mast lift, endless chain pull-down, 4¼" water course throughout, 27'4" mast and exceptional Roadability. Investigate the superior performance of the New M-6.
DRILLING SUPPLIES
FISHTAIL 3-WAY, 4-WAY AND TRI-CONE DRILL BITS
HOISTING PLUGS • SWIVELS • PRESSURE HOSE
DRILL PIPE • PUMPS • KELLYS
Engineering Laboratories, Inc.
PLANTS AT TULSA AND DALLAS
Main Office: 602-624 East Fourth Street, Tulsa 3, Oklahoma, U. S. A.

New Roebling building

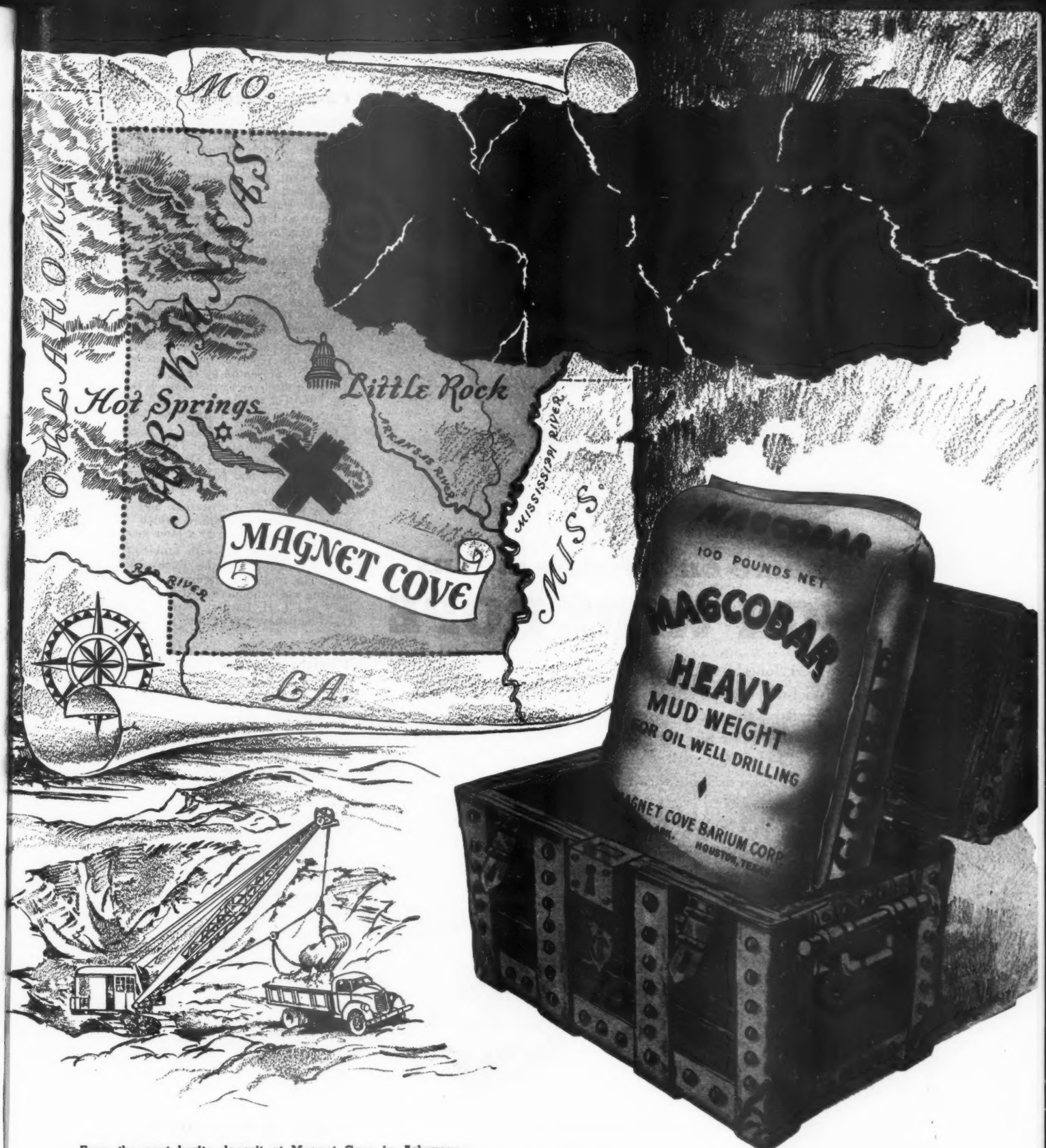
The John A. Roebling's Sons Company of Illinois announces that work is already well underway for the erection of a modern office building and warehouse. The new building has been designed with provision for future expansion, and is situated at 5525 West Roosevelt Road, Chicago.

The structure is designed and situated to facilitate material handling and expedite customer service. The site selected will provide exceptional transportation advantages, because of the proximity of inbound and outbound freight facilities for all railroads entering and leaving the Chicago area.

Drilling contractors meet

On the evening of March 7, some 40 of the California members of the American Association of Oilwell Drilling Contractors, met at the Los Angeles Athletic Club to enjoy a good dinner, to dispose of the business affairs of the local group, and last but not least, to hear a message from Brad Mills, executive secretary of the national association, in the west on a flying visit. Ned Brown of Brown Drilling Company was chairman for the evening and first directed the group in a discussion of chapter problems. One of the most important involved his own resignation and the appointment of a new chairman to take charge of the meetings for the balance of 1946. Karl L. Kellogg was unanimously approved for this assignment and will be charged with planning and conducting all further gatherings until the end of the year.

After these preliminary discussions, Chairman Brown introduced Brad Mills, who launched into a dissertation on the status of the organization and its activities. Particularly he talked at length on the cost manual and accounting schedule that the association has developed and approved for the use of its members. Considerable time and thought has been devoted to this project and the speaker gave it as his opinion that it was well worthy of adoption and practice by the members. Mills also spoke about the research on drillstems that is now being conducted by the national association with the assistance of the local chapters. In all respects his address was highly interesting, informative, and inspiring, and it was thoroughly appreciated by the local members. Incidentally, it might be noted that the approximately 40 members present were responsible for about 65 per cent of the contractural drilling now being carried on in California.



From the vast barite deposit at Magnet Cove in Arkansas comes MAGCOBAR, one of the world's finest mud weights for oil well drilling. Its exceptional purity gives high weight, low viscosity muds that can be maintained at minimum cost while drilling.

The barite deposit at Magnet Cove was discovered many years ago, but all early attempts to mine this mineral ended in failure. It was not until 1939, when the producers of MAGCOBAR developed a process for beneficiating the ore, that this treasure of nature became useful to man. The development of this deposit has proved most timely. During the past two years when barite mud weight has been critically short, due to an increased need for oil to meet the demands of war, two-thirds of all the mud weight material used has come from the Magnet Cove barite deposit. This new source of mud weight not only prevented an acute war-time shortage, but it has reduced the long prevailing market price of this commodity by one-half, resulting in a saving to the oil industry of more than $4,000,000.00 annually.

Surely, MAGCOBAR is a real treasure for the oil industry.

Magcobar

Complete

DRILLING MUD SERVICE

MAGNET COVE BARIUM CORP.

Malvern, Arkansas — Houston, Texas

Export Representative: GUY E. DANIELS, 30 Rockefeller Plaza, New York 20, New York

This name on a reel — means

TOUGH WIRE ROPE

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Thousands of wire rope users—old hands and new—have found "Know Your Ropes" of inestimable value in lengthening life of wire rope. Contains 78 "right and wrong" illustrations, 41 wire rope life savers, 20 diagrams, tables, graphs and charts.

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Casper Engineers Club

The Casper Engineers Club held its March monthly dinner and meeting at the Townsend Hotel, Casper, Wyoming, March 15. Program chairman for the meeting, Fred M. Clement, led an informal discussion of the subject, "Subsurface Pressure and Temperature Data." He displayed 3 makes of pressure and temperature recording instruments that are lowered to the well bottom in making the well survey; the charts on which the record of the survey is automatically traced; the apparatus for accurately reading the charts, and the equipment with which the recording instruments are calibrated to assure proper records in the ranges of the well temperatures and pressures.

A business session followed the program, at which the report of the organization committee was presented by D. T. Hoenshell of General Petroleum Corporation, J. D. Anderson, Ohio Oil Company, and J. A. Deffeyes, Pacific Western Oil Corporation.

Officers were elected as follows: F. M. Clement, Continental Oil Company, president; R. M. Churchwell, Ohio Oil Company, vice president; and J. R. Schwabrow, U. S. Geological Survey, secretary-treasurer.

The proposed constitution and by-laws were submitted for study, which will be taken up for adoption at a later meeting.

The programs deal with problems of oil field development in the Rocky Mountain area. The topic for discussion at the April meeting was announced, "Reservoir Mechanics," and J. H. Barnett, Stanolind Oil and Gas Companay, was chosen program chairman.

Field representative

William A. Pitts, formerly of Los Angeles, California, has been named field representative in the Mid-Continent territory by Baash-Ross Tool Company.

Pitts brings a background of some 20 years' field experience to his new position. Prior to his appointment as field representative for Baash-Ross, Pitts was associated with the Chain Belt Company, with Regan Forge and Engineering Company, and with the Axelson Manufacturing Company. Pitts' district headquarters will be Oklahoma City and will include Oklahoma, West Texas, Kansas, and Illinois.

Appoints representatives

Wm. W. Nugent and Company, Inc., Chicago, Illinois, have appointed several new representatives, as follows:

Crofton Diesel Engine Company, Foot of G Street, Fishermen's Wharf, San Diego, California.

Casey Boat Building Company, Fairhaven, Massachusetts.

Dempsey Equipment Company, 1 Star Square, Long Island City, New York.

George A. Krutilek, P.O. Box 227, El Paso, Texas.

Olympia Supply Company, 1743 First Avenue, Seattle, Washington.

Heads Heil company

Joseph F. Heil was elected president of The Heil Company, Milwaukee, Wisconsin, at the annual meeting of its board of directors. Julius P. Heil, founder of the company and president since its inception, will continue actively in the business as director and treasurer.

When Julius P. Heil was elected Governor of the State of Wisconsin in 1938 and again in 1940, much of his time was necessarily devoted to matters of state and Joe was advanced to the active management of the company as executive vice president.

Bovaird changes

With the building already under construction for a new store at Odessa to serve West Texas, Bovaird Supply Company announces the appointment of L. W. Bartheld as district manager in the new territory and D. W. Cunningham as store manager.

Bartheld, veteran in the oil well supply business, is no stranger in the West Texas area. He operated a machine shop in Odessa

L. W. Bartheld

D. W. Cunningham

in 1937 and 1938. He was manager of the Bovaird Salem, Illinois, store from 1938 to 1942, and for the last 3 years has been district manager for Bovaird in Illinois. Bartheld was 10 years with Oil Well Supply Company at Seminole before joining Bovaird in Ada, Oklahoma, during the Fitts pool development.

Cunningham goes to Odessa from Oklahoma City, where he has been a special sales representative for Bovaird. Cunningham is also a seasoned supply salesman, having been a field representative at Russell, Kansas, and store manager at Grayville, Illinois, before going to Oklahoma City. Cunningham was formerly with Hughes Tool Company.

Bovaird also announces that V. P. McAnally has just returned from the army to his old job as district manager for Illinois, which he left to enter the military service in 1942. McAnally entered the army as a lieutenant, served 2 years in England and Europe, during which time he was elevated to the rank of captain.

Poole on foreign trip

Ray Poole has been appointed manager of the Foreign Service Department for Security Engineering Company, Inc., and left Los Angeles recently for a 6½ month trip to Mexico and South America in which he will cover all the major oil fields of the northern part of the continent.

Ray Poole

His itinerary calls for visits in the following countries in the order named: Mexico, Colombia, Venezuela, Trinidad, Brazil, Bolivia, Peru, and Ecuador. From Ecuador he will make a return coverage of the oilfields of Colombia, Venezuela, and Mexico and will arrive back in Los Angeles on July 31.

Ray first started his career in the oil fields of Texas in 1923 and since has had years of practical experience in drilling, producing, refining, and sales. In 1925 he went to Colombia for Tropical Oil Company, where he was employed for a period of 4 years gaining valuable knowledge on the operations and requirements of foreign oil companies.

Plans development

Prior to the war, The J. M. Ney Company, established in 1812, was primarily concerned with the manufacture of precious metal alloys for the dental industry although some experimentation had been carried on in the industrial field. With the outbreak of hostilities and a greatly accelerated demand for electrical apparatus of all sorts, manufacturers of radar, aircraft instruments, communication systems, and other precision equipment became interested in the possibility of using precious metal alloys to increase the output, life, and accuracy of the contacts used in their equipment. Working with the Ney research department, it was found that Ney precious metal alloys had the necessary qualities and characteristics required to give long life and maintained accuracy to measuring equipment and electrical apparatus, with particular application to radar.

Certain of these Ney alloys were found to be especially suitable for electrical contacts on potentiometers and other sliding contact applications.

Gold-platinum-palladium alloys are now finding a wide application in the peacetime industrial field where Ney-improved contacts will be used in potentiometers for such things as computer devices, telephone and telegraph equipment, as well as precision instruments for commercial aviation and radar. In anticipation of this growing industrial interest in its products, the Ney Company has expanded the scope of its laboratory facilities for research on precious metal alloys for potentiometer and other sliding contact applications. Included also will be research and further development on alloys for use in radar and precision equipment.

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The four volumes now in preparation cover: The Optimum Rate of Production; Reserves and Well Spacing; Condensate and Natural Gas Production; and Primary and Secondary Production Methods.

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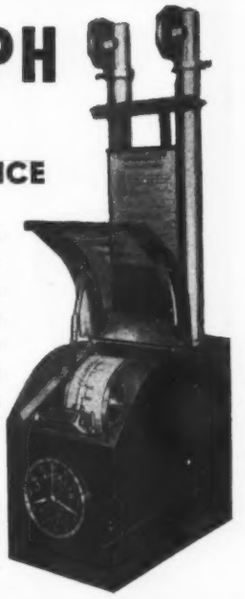
MECHANICAL

WELL LOGGING SERVICE



Hundreds of operators now depend on this mechanical recorder for a permanent record of drilling time and coring time in minutes per foot. Foot by foot, the rate of drilling is measured by the Geolograph, and graphically recorded along with such drilling operations as round trips, connections, and shut-down time.

Reasonable rental rates for Geolograph Service make it available to all operators. Write for further details and availabilities.

"TIME WILL TELL"

THE GEOLOGRAPH CO.

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President Trout receiving bronze plaque from H. W. Ragland. Others in the picture, left to right, are Dutch Oberpriller, moulder, Jess Belote, machinist, C. B. Ragland, trailer division superintendent, and Al Cudlipp, vice president.

Trout honored

In appreciation of his leadership of more than 40 years as head of the Lufkin Foundry and Machine Company, Lufkin, Texas, employes, numbering some 800, gathered at the Lufkin Country Club for a surprise party and barbecue honoring W. C. Trout, president, upon the occasion of his 72nd birthday.

The highlight of the party came when H. W. Ragland presented Trout with a beautiful bronze plaque in behalf of all employes. The plaque was inscribed: "Presented to W. C. Trout April 6, by all the employes of the Lufkin Foundry and Machine Company in affectionate appreciation of his helpful, friendly, and understanding leadership and in token of their great esteem." Another presentation was the framed hinge from the first shop door, more than 50 years old, preserved by Jess Belote since the old plant's dismantlement more than 25 years ago. With the framed hinge was the poetic evaluation of Trout's leadership by one of the foundry employes.

Trout, under whose guidance the Lufkin Foundry and Machine Company has grown from a small repair shop to one of the great manufacturing plants of the Southwest, was visibly impressed by the tribute extended him by his employes. He expressed his appreciation for the fine birthday party and presents, and praised the loyalty of the workers.

Jack C. Dionne, publisher of the Gulf Coast Lumberman and long-time friend of the honoree, praised Trout, both as an employer and as a citizen.

Morris Frank, of the Houston Post, former Lufkinite, also paid tribute to Trout.

W. H. Ragland, the boilermaker, C. B. Ragland, trailer division superintendent, Jess Belote, machinist, employes for more than 40 years, were on hand to honor "the boss."

A. E. Cudlipp, vice president of the Lufkin company, who has been with the organization more than a quarter of a century, acted as master of ceremonies for the affair.

Motor distributor

The Midwestern Engine and Equipment Company, new Tulsa firm, has been awarded the midwestern distributorship for Continental Motors Corporation.

F. E. Stanley is president and general sales manager, G. O. Glandon is assistant sales manager, and Armon H. Bost is secretary-treasurer.

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SPANG
PROSSER-TYPE
SWIVEL ROPE SOCKET

Fig. D312

The Spang Prosser-Type Swivel Rope Socket is made of a grade and type of steel particularly suited to this product.

First it is forged, heat-treated, finish-turned and finish-bored. Then, a second heat treatment gives it a very uniform toughness and the proper hardness both inside and out. Next, the internal tool joint is threaded and the side holes drilled.

The result—a swivel rope socket of superior quality, delivering maximum service.

THE HIGHER STANDARD

SPANG & CO.
BUTLER, PA.

YOUR DEALER SELLS SPANG TOOLS

Tank license arrangement

Wyatt Metal and Boiler Works, Houston and Dallas, Texas, announces effective April 1 an important addition to its services as the result of a license arrangement entered into with the General American Transportation Corporation, Chicago, exclusive licensers of the widely known Wiggins tank roofs, for the sale, fabrication, erection, and servicing of this equipment in 8 states throughout the oil country of the Mid-Continent and southeast.

The Wyatt license territory includes the states of Arkansas, Oklahoma, New Mexico, Texas, Louisiana, Mississippi, and Alabama, and that part of Florida lying west of the Apalachiola River.

Through this arrangement Wyatt will add to its tank fabrication and erection services the many exclusive advantages provided by the popular Wiggins roofs including the following:

Improved Wiggins floating roof (Hideck and Lodeck), a tank roof that floats on the liquid in the tank.

Improved Wiggins breather roof, a tank roof that changes the gas volume of the tank by flexing a steel diaphragm, which forms all or a part of the roof, the peripheral edge of which is attached at or near the top of the tank.

Improved Wiggins balloon roof, a tank that changes the gas volume of the tank by flexing all or part of a steel diaphragm superimposed over a second annular shaped steel diaphragm, the latter normally extending outwardly from the top of the tank with the inner edge of said annular shaped diaphragm attached to the top of the tank.

Improved Wiggins steel balloon, a gasholder comprising an upper flexible diaphragm and a lower annular shaped flexible diaphragm and normally built on the ground and not as a part of a tank.

Improved Wiggins dry seal lifter roof, a roof for a tank, the principal function of which is to store liquid, the function of the roof being to change the gas volume of the tank by rising vertically. It has a skirt that telescopes the tank side wall and a curtain seal between the tank and the roof.

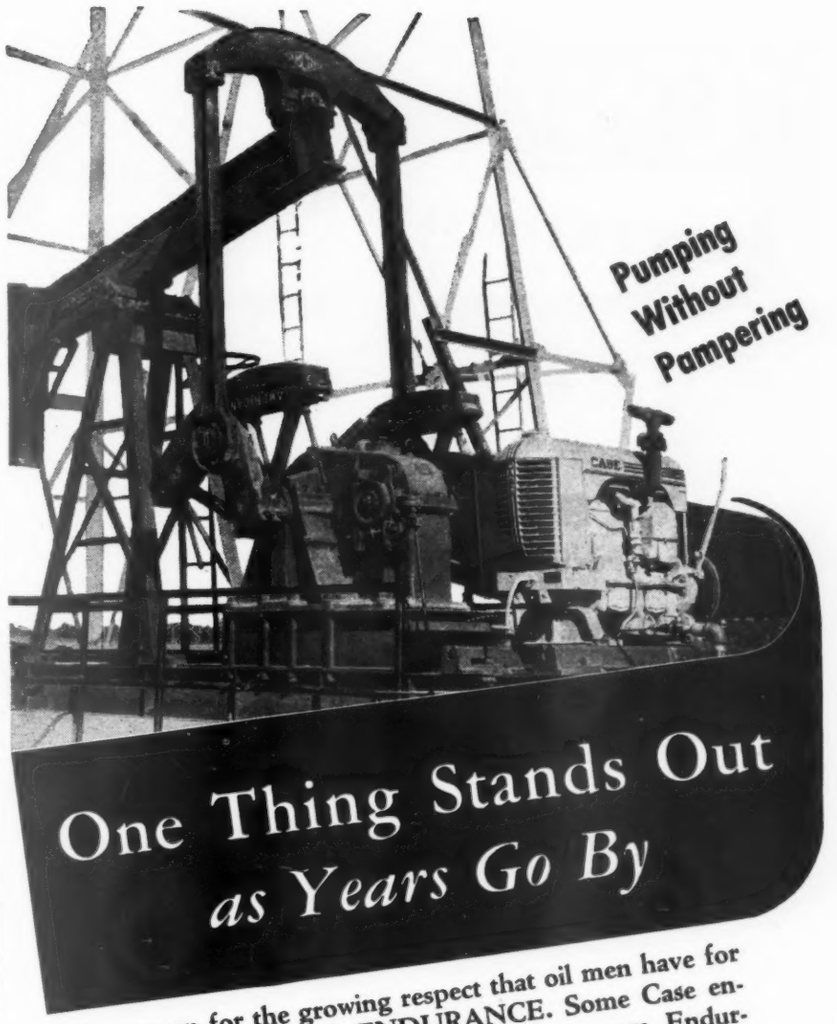
Improved Wiggins dry seal pressure type gasholder, a gasholder that is not normally built in connection with a liquid storage tank, the principal function being to store gas. It may be built in either of two ways according to present designs: (1) As a movable piston inside a tank, with a curtain seal between piston and tank wall, or (2) as an outside riser disposed over a stationary piston with a curtain seal between piston and riser.

AAPG award

Dr. Horace G. Richards of Philadelphia has been chosen as the second recipient of the President's Award of the American Association of Petroleum Geologists.

This award was established in 1944 and it is designed "to honor and reward the younger authors of original articles published in the AAPG Bulletin during each calendar year." The selection committee is made up of 10 association members and is headed by Frank R. Clark, consulting geologist of Tulsa, former president of AAPG.

The honor was conferred on Dr. Richards, associate curator of geology and palentology of the Philadelphia Academy of Natural Sciences, during the annual convention of the AAPG, which began in Chicago on April 1. AAPG President M. G. Cheney made the presentation, which consisted of a cash award of $100 and a certificate.



One Thing Stands Out
as Years Go By

Main reason for the growing respect that oil men have for Case Oilfield Engines is ENDURANCE. Some Case engines have run non-stop for as much as two years. Endurance is why they regularly run months longer before major overhaul, why forced shut-downs are rare, why minor upkeep is really minor.

One secret of this endurance is the exceptional protection provided against destructive dust and dirt. Another is the lubricating system that works "for sure" in wide extremes of weather. Altogether, it comes from making every part a bit better than might seem necessary.

Shown above on a job in the East Texas Oilfield is the 42 H.P. Model "DE." Other Case Oilfield engines are the 28½ H.P. "SE" and the 61 H.P. "LAE." For full information, call the distributor who maintains service in your area. J. I. Case Co., Racine, Wis.

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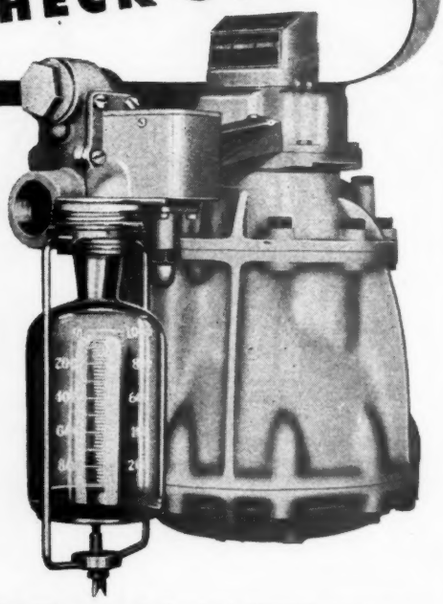
BOWSER
ESTABLISHED 1885

WELL-CHECK SYSTEM

SAMPLES
and
METERS
CRUDE PRODUCTION
AT THE WELL
Automatically



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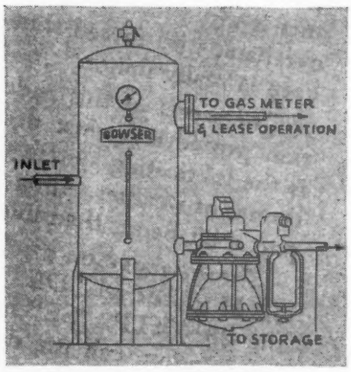
QUALITY

with true proportionate sample provided by Bowser Automatic Oil Well Sampler.

QUANTITY

with Bowser Special Oil Field Meter. Dependable operation—no metal-to-metal contact.



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Write today for the new Bowser booklet of equipment for modern oil fields.
Bowser, Inc., 1329 Creighton Avenue,
Fort Wayne 2, Indiana

LIQUID CONTROL SPECIALISTS SINCE 1885

Rejoins Cooper-Bessemer

The appointment of Arthur Abel as sales engineer on the staff of its Odessa, Texas, branch is announced today by Stanley E. Johnson, director of sales of The Cooper-Bessemer Corporation of Mount Vernon, Ohio.

Arthur Abel

Abel, a graduate of Oklahoma A. and M. University, where he majored in mechanical engineering, was connected with Cooper-Bessemer's Los Angeles office several years ago and is well-known in the West marine and industrial circles.

H. E. Scraggs is branch manager of the Odessa office, in charge of southwest Texas sales operations.

Executive vice president

Thermoid Company, Trenton, New Jersey, announces the election of Dwight P. Allen as executive vice president. Allen has been vice president and director of manufacturing operations, and before that was head of sales to car manufacturers.

Allen has been associated with Thermoid for 12½ years, beginning with the organization in October, 1934. Before joining Thermoid, he was employed by Chrysler Motors in Detroit and before that as an engineer with Wagner Electric Company in St. Louis.

Division sales manager

Homestead Valve Manufacturing Company of Coraopolis, Pennsylvania, has appointed William E. Thomas division sales manager in charge of valve sales in the southeastern states territory with headquarters in Atlanta, Georgia.

Thomas was formerly southeastern division manager of the Chicago Metal Hose Company, and has nearly 10 years industrial engineering sales experience.

A graduate of the University of Pennsylvania, "Bill" Thomas is well known, and brings to valve users in the southeastern states area, a fine technical background and familiarity with their requirements.

Griffis a partner

G. G. "Tuffy" Griffis has become a partner in the Holland Construction Company, it was announced recently by H. T. "Bus" Holland, Jr., president.

Griffis has spent 25 years in the pipe line construction business throughout the world, principally in South America and Alaska. He was recently director of the Canol Project in Alaska.

The Holland Construction Company also announces it has acquired a large amount of heavy machinery and equipment, which will make possible the handling of major pipe line construction jobs in any type of topography.

H. T. Holland, Jr.

G. G. Griffis

Nomads hold open meeting

Los Angeles Nomads got off to an auspicious start on March 13, in their first open meeting of the year at the Mayfair Hotel, when with the exception of Tom Martin and Dan Duncan, all the new officers were in their appointed places, and were stimulated by an unusually large attendance. Opening the meeting, Bill Bettis called for unstinting help from the members in keeping the record of Los Angeles chapter at its present high level. He then called for a vote of thanks to Hi Cassidy and his assistants for the able manner in which they had taken care of the arrangements for the Inaugural Ball at the Biltmore.

Earl Daniels took charge of the introduction of a sizeable gathering of foreign guests, and did a tiptop job, presenting the following: Herman J. Bowman, Arabian American Oil Company; J. W. Clampitt, Iraq Petroleum Company, Kirkuk, Iraq; J. R. Coleman, Lieut. U. S. N. R., Arctic Contractors, Fairbanks, Alaska; Ralph A. Davis, International Ecuadorian Petroleum Company, Guayaquil, Ecuador; E. M. Donovan, B. O. C. Ltd., Burmah, India; A. F. Driskill, Iraq Petroleum Company, Haifa, Palestine; Don W. Jopling, Arctic Contractors, Fairbanks, Alaska; J. W. Killingsworth, Iraq Petroleum Company, Kirkuk, Iraq; Jaime Merino, Petroleos Mexicanos, Mexico; Juan P. Pedretti, Union Oil Company, Paraguay; Jack Stovall, Arabian American Oil Company; C. M. Williams, unattached.

Speaker of the evening was Howard Pyle, ex-Union Oiler, now vice president of the Bank of America, in charge of its oil division, who gave a recitation of the difficulties involved in keeping one of the biggest armies in history supplied with petroleum products, and then told how these difficulties were overcome. Attached to the staff of General Eisenhower as petroleum officer, Howard was later loaned to General Montgomery, so that he was an "on the spot" witness of some of the great events of the war, besides being the director of that vital and complex operation—petroleum supply. His presentation was interesting, illuminating, and was well received by one of the largest groups to attend a Nomad meeting.

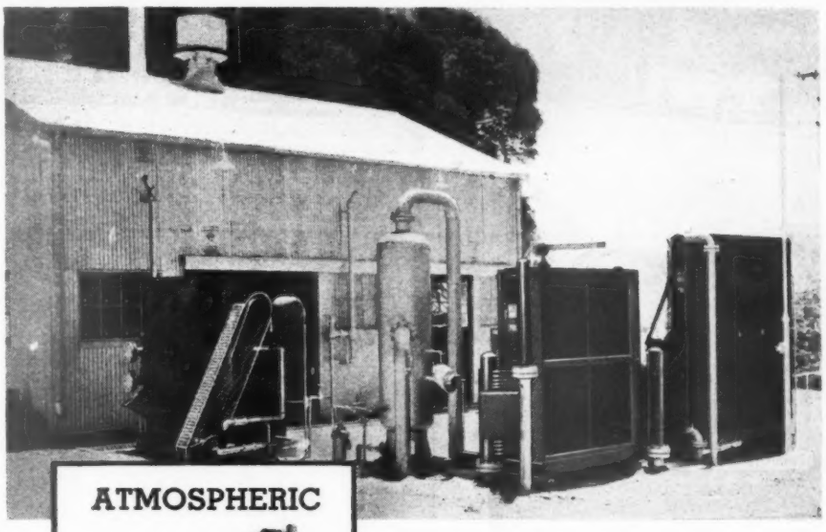
Gordon Jackson promoted

H. John Eastman, president of the Eastman Oil Well Survey Company, has announced the appointment of Gordon Jackson, former chief engineer, as vice president and general manager of the Eastman organization.

Gordon Jackson

Jackson is well qualified for his new position, both in training and in experience. After his graduation with an engineering degree from the University of California at Berkeley, he worked in the field in various engineering and geological capacities prior to starting in the field department of the Eastman company. He had advanced through every phase of this company's controlled directional drilling and oil well survey work to the position of division chief engineer of the California division when, in 1945, Eastman advanced him to the position of chief engineer. On January 1 of this year he was made vice president and general manager of the Eastman Instrument Company, manufacturing division of the parent organization, and in March was promoted to his present position.

YOUNG
DOES *DOUBLE-DUTY* IN GAS COOLING



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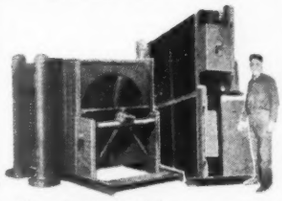

"Streamaire" Units are made for single and double stage cooling. Cooling-air is circulated by high capacity fan.

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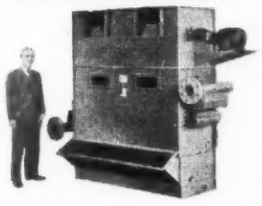
EVAPORATIVE



"Streamaire" Evaporative Gas Cooler, available with coils designed for high pressures and all types of gases.

Highly efficient gas cooling at low cost may be accomplished by using "Streamaire" Two-Stage Atmospheric and Evaporative Coolers designed by Young. A typical example of Young engineering for the petroleum industry is the Two-Stage Atmospheric Unit (center) which has a 70 lbs. per sq. in. discharge pressure in the first stage and 225 lbs. per sq. in. in the second. The Evaporative cooler (left) accomplishes the final stage of cooling, from an approximate atmospheric to an approximate wet bulb temperature. Engine and compressor jacket water are also cooled by the "Full Flow" Engine Jacket Water Cooler (right). Call upon Young Engineers to solve your cooling problems; no obligation.

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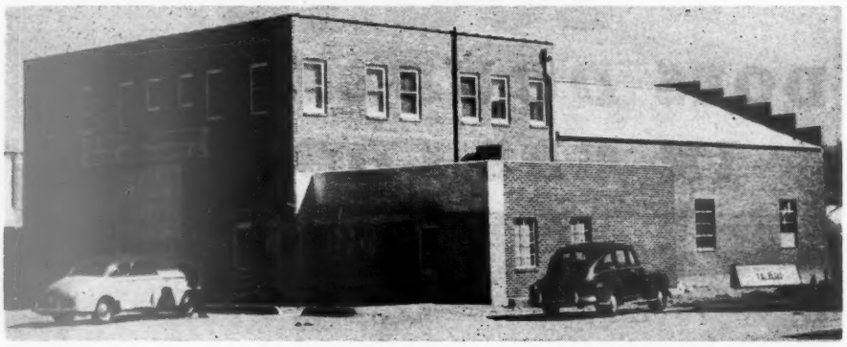
Mid-Continent Distributors
THE HAPPY COMPANY
Drawer 770, TULSA 1, OKLAHOMA

West Coast Distributors
A. R. FLOURNOY COMPANY
609 S. Grand Avenue, LOS ANGELES 14, CALIFORNIA

General machine moves into new building



General Machine and Supply Company, of Wichita Falls, Texas, has moved into its new building at 702 West 2nd Street, Odessa, Texas.

The Odessa branch was opened several years ago to bring Le Roi products and service to the West Texas operators, and has grown every year with the development of the fields. Its new building is a two-story, all-brick structure, and incorporates a large suite of offices, a greatly enlarged stock of engines and parts, as well as a super service shop completely equipped and adequately staffed with factory-trained personnel.

At the house-warming activities was a group of 120, made up of drilling contractors and superintendents, in addition to 4 representatives of Le Roi Company.

Kellogg officers

The M. W. Kellogg Company, petroleum and chemical engineers and fabricators of heavy industrial equipment, of Jersey City, New Jersey, and New York, New York, announce that the following officers have been elected by the board of directors: M. W. Kellogg, chairman of the board; H. R. Austin, president; F. E. Johnson, vice chairman of the board, and L. H. Harvison, executive vice president. The creation of the two new executive positions of chairman and vice chairman of the board was necessitated by the company's proposed expanded program of industrial engineering, manufacturing, and process development, it is announced. Petroleum engineering will continue to play a major part in the company's activities, and service to the other process industries, which has increased markedly in recent years, will be still further developed.

H. R. Austin

L. H. Harvison

The plans for widening the base of the M. W. Kellogg Company's operations in the immediate future also provide for extended study of the commercial possibilities of the new processes, equipment, and materials developed in connection with Kellogg's work on the atom bomb project, at Oak Ridge, Tennessee, as well as utilizing the metallurgical and fabricating advances achieved at the company's plant and laboratories at Jersey City.

Manager distribution

Howard Pape has been named general manager of distribution for Jarecki Manufacturing Company's oil country distribution.

Pape joined Tide Water Associated Oil Company in 1915 and a year later joined the Mid-Continent Petroleum Corporation, advancing to the position of chief engineer and mechanical superintendent.

In 1927 he became associated with Crane Company, specializing in the development, sale, and distribution of its products to the oil industry. He left Crane in 1944 to become vice president of the W-K-M Company of Houston, Texas.

The *value received* from an oil field engine *is not measured* so much by its *cost* but rather by the *performance* that it gives—an engine that will operate 24 hours per day, day in and day out giving low cost, efficient performance free of mechanical breakdown is the one that *stands out* in the final analysis. *25,000 hours* of *continuous service* with stops only for oiling and greasing *is not uncommon* with *MM Oil Field Engines*. All the low cost, high performance features are *"built-in"* on *every* MM Oil Field Engine—that is why we say when *you* buy an Oil Field Engine *"It's Performance that Counts"*.

MM Oil Field Engines are built in 7 sizes to fit most every oil field application:

165-4A . . .	3⅝x4, 4 cyl.		
206-4A . . .	3⅝x5, 4 cyl.	HUA . . .	4⅝x6, 6 cyl.
KUA	4¼x5, 4 cyl.	MEU . . .	8x9, 4 cyl.
LUA	4⅝x6, 4 cyl.	NEU . . .	8x9, 6 cyl.

For complete information on MM Oil Field Engines, Write:

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Brewster party

On March 30 at its new plant on Market Street, Shreveport, Louisiana, The Brewster Company held an informal party to announce the new N-10 rig. Drillers and supply people, as well as Shreveport businessmen and city officials, were invited to a barbecue luncheon and demonstration.

The rig that was demonstrated was built especially for the Crow Drilling Company of Shreveport. The demonstration included running the 4 motors of the assembly and all parts of the drawworks. Dale Evans, driller for the Crow Drilling Company, and Brewster officials, showed the functioning of all controls.

Also on display was the complete line of Brewster swivels, crown and traveling blocks, rotaries, and other equipment.

Proud owner of the first Brewster N-10 drilling rig is R. H. Crow (third from right) of the Crow Drilling Company, Shreveport. Among those who witnessed the demonstration were (left to right) Curtis Tanner, City Marshal; Dale Evans, driller, Crow Drilling Company; H. A. Harlan, The Brewster Company; R. H. Crow; Ed Jacobs, Shreveport Railways; A. Olin Price, general manager, The Brewster Company.

Fluor honored

The Fluor Corporation, Ltd., Los Angeles, California, was honored for its work on the Atomic Bomb Project, along with other participating firms and universities, at a dinner held February 26 in the Grand Ballroom of the Waldorf-Astoria Hotel, New York City. President P. E. Fluor attended the affair to receive the award on behalf of the company.

Honored guests, besides executives of the participating organizations, were Major General Leslie R. Groves, officer in charge of the project; Col. Kenneth D. Nichols, district engineer, and other representatives of scientific, engineering, and educational institutions.

The Fluor Corporation constructed a substantial portion of the cooling towers at Oakridge, Tennessee, home of the atom bomb.

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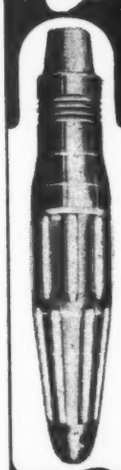
ROLLER



✱ The smooth and continuous rolling action of the hardened steel roller pins efficiently and economically "does the job" in a minimum of time and without excessive friction, vibration or hammering which may damage casing.

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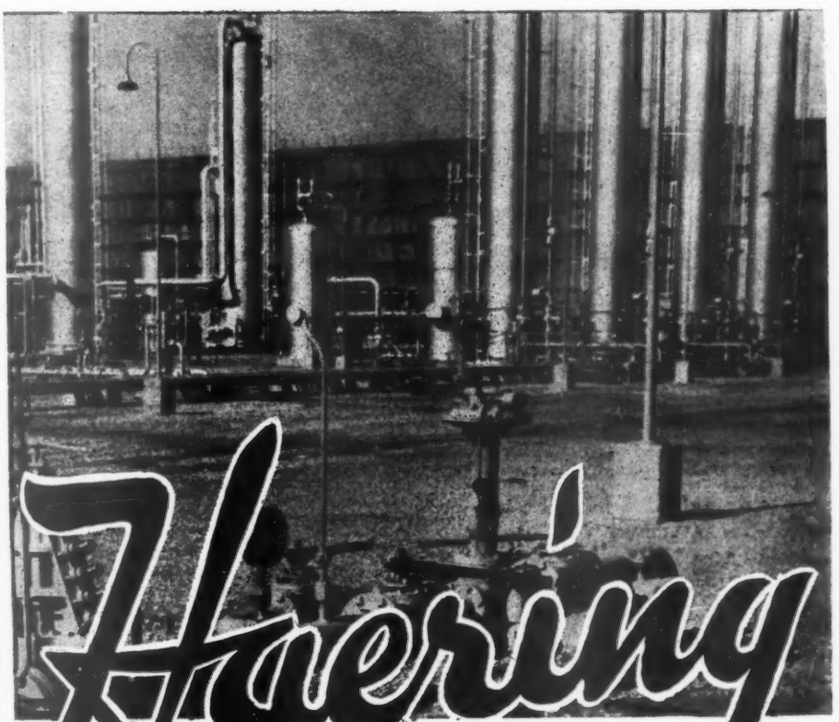

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of Scale and
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Knowlton resigns

Don R. Knowlton, who resigned April 1 from Phillips Petroleum Company as manager of the foreign department and as executive vice president and member of the board of directors of the foreign subsidiaries of Phillips, has entered into a partnership with Frank M. Porter of the Fain Porter Drilling Company with offices in the First National Bank Building, Oklahoma City, Oklahoma. The new firm is to be engaged in drilling contracting and will establish a consulting petroleum engineering service after making a survey to determine the needs of the petroleum industry in the various phases of petroleum engineering.

Don Knowlton

Shortly after Pearl Harbor, Knowlton was called to Washington by Secretary Ickes and Deputy Petroleum Administrator Ralph K. Davies to become National Director of Production, which post he held for 2½ years, being released on June 1, 1944, to take the position of manager of the newly formed foreign department of Phillips Petroleum Company.

Augment staff

Continuing its policy of expansion in field welding engineering service, The Lincoln Electric Company, Cleveland, Ohio, has added the following representatives to 4 of its district field office staffs.

John F. McFeeters has joined the staff of welding engineers in the Kansas City, Missouri, office. McFeeters, a former native of Gower, Missouri, is a graduate of the Lincoln School of Arc Welding and was employed as mechanic and welder by the State of Missouri for 6 years. He later was made welding instructor by the Joplin, Missouri, school board in its vocational training program.

Shortly after the outbreak of the war, McFeeters enlisted in the Seabees and received his discharge from service after 18 months of duty in the Pacific theater.

Hubert G. Hinkle has been assigned welding engineer in the Columbus, Ohio, area. Hinkle received his education at Cleveland, Ohio, and in June, 1941, he became associated with Lincoln Electric where he remained until he entered Army service.

After several months as an infantry private, Hinkle joined the Air Corps and received his pilot's wings at Marfa, Texas. He was released from military service in September, 1945.

K. S. Lamb has been named welding engineer in the New York territory. Lamb attended the University of Buffalo and left school in 1939 to work in the oil industry. Later he joined the Lummus Construction Company, where he traveled extensively during the firm's refinery and plant building projects.

Lamb entered military service in 1942 and completed a course in engineering at Keesler Field, Miss. He received further training at the Pratt & Whitney Engine School, Detroit, Michigan, before being transferred to Trinidad, British Guiana, French Guiana, and finally to Brazil. He also served as flight chief in North Africa before his discharge as master sergeant a few months ago.

Thos. W. Day has been appointed welding engineer at the St. Louis, Missouri, office. Day was educated at the University of Texas. His military training before joining Lincoln Electric included 2½ years as coast artilleryman in Alaska. He was later sent with the field artillery to Europe to participate in the campaign of Northern France.

Board chairman

Directors of Foster Wheeler Corporation have elected H. S. Brown chairman of the board to succeed his brother, the late J. J. Brown. Brown will continue as president of the corporation in addition to his new post. David McCulloch, executive vice president, was named chairman of the executive committee to succeed H. S. Brown. All other officers were reelected.

Director of research

Thermoid Company, Trenton, New Jersey, announces the appointment of H. C. Anderson as director of research.

Anderson, a chemical engineering graduate of Iowa State College, was formerly with The Flintkote Company, Chrysler Corporation, and Ford Motor Company, respectively, in research, engineering, and managerial capacities.

His experience in research and development in the industrial and automotive fields qualifies him to play an important part in Thermoid's plan for the future.

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Joins UOP

Dr. Walter Miller, who on March 1 retired as vice president in charge of manufacturing for Continental Oil Company, has been retained by Universal Oil Products Company as a consultant on refining techniques and operations.

Dr. Walter Miller

Since 1909 Dr. Miller has been actively associated in the refining industry, and his wide experience and broad knowledge will be particularly valuable to Universal and its licensees.

Having had years of practical experience in the operation of both small and large refineries, ranging from 400 to 30,000 bbl. per day, Dr. Miller is exceptionally qualified to advise on any problem relating to the operation of a refinery. He has kept pace with every refining development, and has supervised the operation of most cracking processes that have been commercially employed in American refineries.

During World War II Dr. Miller was a leader in the 100-octane gasoline program, and served on several important committees in the development and successful operation of that program.

Sales manager

The Lone Star Cement Corporation, with headquarters in New York City, has announced the appointment of R. J. Mahon as general sales manager, and J. G. West as assistant general sales manager.

Reservoir engineering

A conference on reservoir engineering is to be held April 22 to 26 at College Station, Texas, sponsored by the Petroleum Engineering Department of Texas A. and M. College. Meetings will be held in Room 140 of the Petroleum Engineering Building.

On Monday, April 22, from 1:30 to 5 p.m., lectures will be given on elements of production, mechanics and characteristics of reservoir rocks. From 7:30 to 9:30 p.m., there will be a round table discussion.

On Tuesday, April 23, 9 to 12 a.m., lectures will be on composition of hydrocarbons, and from 1:30 to 5 p.m. on properties of reservoir gases. A round table discussion will be held from 7:30 to 9:30 p.m.

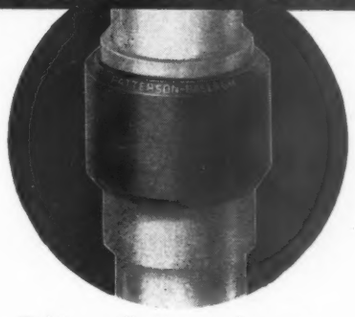
Wednesday, April 24, from 9 to 12 a.m., lectures will be on properties of reservoir liquids, and from 1:30 to 5 p.m. on separator samples and equilibrium constants. Another round table discussion will be held from 7:30 to 9 p.m.

Thursday, April 25, 9 to 12 a.m., lectures will be on displacement of oil by water and gas, displacement of oil and water by gravity, invasion factors and patterns. From 1:30 to 5 p.m. lectures will be on displacement of condensate by cycling. A round table discussion will be held from 7:30 to 9 p.m.

Friday, April 26, from 9 to 12 a.m., lectures will be on volumetric balances.

Hotel reservations should be made direct to Aggieland Inn, College Station, or to the LaSalle Hotel, Bryan, it is announced. For dormitory rooms contact Harold Vance, Petroleum Engineering Department, Texas A. and M. College, College Station.

"Best Bet Yet"
SAVE YOUR TUBING!



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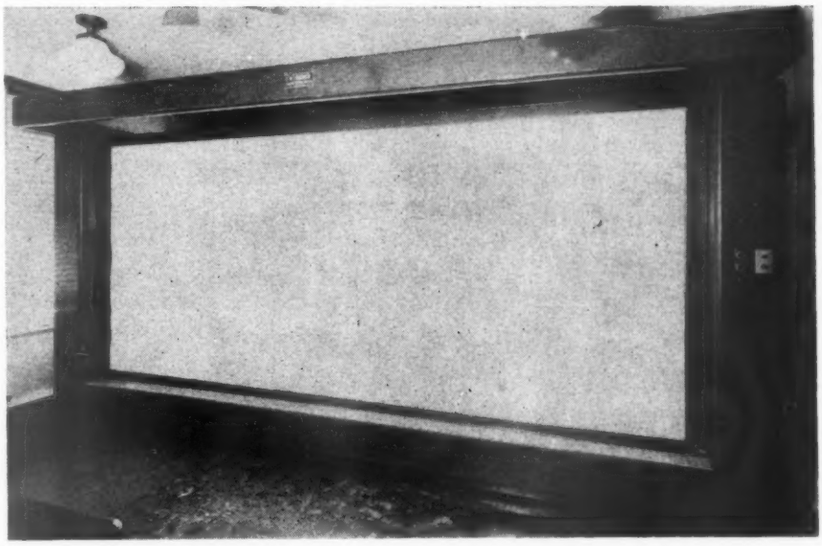

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- Electrical motor drive using standard current, simple and fast operating. Control buttons on each side of cabinet, also remote control for operation from desk or foot operation while working on map.
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Unit Substations

Manager sales promotion

George B. Cushing has been named manager of sales promotion for the National Supply Company, it was announced by A. E. Walker, chairman of the board and president.

G. B. Cushing

Cushing, sales promotion manager for A. M. Byers Company for the last 17 years, will direct the sales promotion activities of National Supply Company including the Spang-Chalfant, Superior Engine, and oil field machinery and equipment divisions. These activities will include the advertising and market development programs of the company.

In announcing Cushing's appointment, Walker stated that A. P. Colby will continue as the company's advertising manager.

Chief engineer

Albert J. Hulse, formerly with Carnegie-Illinois Steel Corporation at Pittsburgh, Pennsylvania, has joined The Youngstown Sheet and Tube Company as chief engineer. He succeeds J. D. Jones, who left the company about a year ago.

Hulse, a native of Washington, D. C., was in officers' training school when World War I ended. He came to Youngstown district in 1925 as chief draftsman for Trumbull Steel Company in Warren, after serving as draftsman for several steel companies. Later, he became assistant chief engineer for the H. A. Brassert Company, consulting engineers of Chicago.

In 1935, he went with Carnegie-Illinois Steel Corporation as assistant chief engineer at their South Chicago Works, and was appointed chief engineer a short time later. A few weeks before Pearl Harbor, he was transferred by U. S. Steel Corporation to Columbia Steel Company to fill the position of chief engineer on the construction of Geneva Steel Works for the U. S. Government at Provo, Utah. Upon completion of the Geneva project, he returned to Carnegie-Illinois as senior staff engineer in the Pittsburgh office.

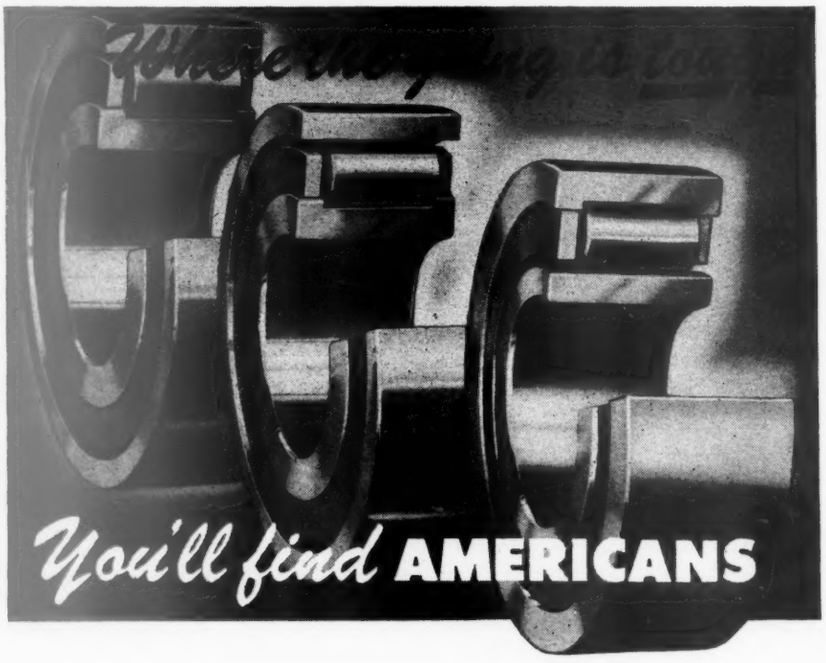
Announces promotions

Appointment of Walter F. Myers, as assistant district manager of The Cooper-Bessemer Corporation's Washington, D. C., office to succeed T. E. Kraner, recently appointed manager of the company's Venezuela branch, is announced by Stanley E. Johnson, vice president and director of sales.

Walter F. Myers

Johnson also announced the appointment of Laurence B. Hume as sales engineer and service supervisor for the territory covered by the Washington district office.

Myers joined Cooper-Bessemer as a member of the Washington staff January 1, 1945. Formerly he had been in the construction and sales engineering field for about 25 years.



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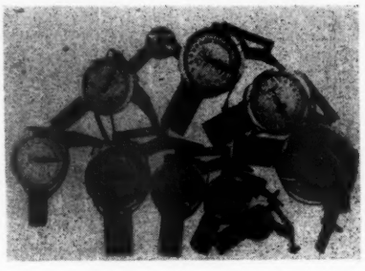

10 of the 20 Models we manufacture. 40,000 pounds to 500,000 pounds. A special scale for any job.

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Two promoted

Two General Petroleum Corporation production men well known in California oil development for many years have been advanced to new positions. They are Bruce H. Robinson, who is made assistant manager of the production department; and Richard R. Shinn, who is named general superintendent of the production department.

Bruce Robinson has been with General Petroleum since 1925 when he joined the field staff as a timekeeper. From various clerical and accounting assignments he worked into engineering and became assistant production engineer in 1930. Promotions to assistant superintendent, division superintendent, and general superintendent of the production department followed. From the last named position he is advanced to assistant manager of the department.

Richard Shinn

Bruce Robinson

Richard Shinn was first employed by General Petroleum as a foreman in the Taft field in 1913. Later he served as a company representative in Texas, Louisiana, and Mexico, but returned to California in 1921 as superintendent of production at Ventura. In 1924 he was made field superintendent at Taft, and had his residence in that oil city for the next 20 years, the latter 6 as division superintendent of the San Joaquin division. He was the first chairman of the San Joaquin chapter of the American Petroleum Institute, served on various committees of the Institute in that area, and is a member of Petroleum Production Pioneers.

November of 1944 brought Shinn's appointment as assistant general superintendent of the production department and removal of Taft to the office at Vernon. His new advance to general superintendent moves him into the home office, Higgins Building, Los Angeles.

Win safety award

The Fluor Corporation, Ltd., Los Angeles, California, was awarded second place in the heavy construction division of the 1945 accident prevention contest sponsored by the Associated General Contractors of America.

Division manager

Captain Fritz Taves, a member of the California division staff of Schlumberger Well Surveying Corporation since 1935, has been appointed California division manager, succeeding A. A. Perribinosoff.

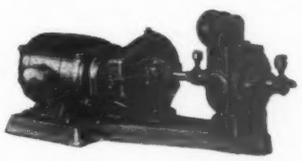
Fritz Taves

Taves, who was until recently a captain in the United States Naval Reserve, has served four years with the United States Navy in various capacities. He held at one time the post of commanding officer at the Elk Hills Naval Reserve in California.

PUMPS for the PETROLEUM INDUSTRY

Write for Bulletin No. 102 which shows why and how

BLACKMER PUMPS are SELF-ADJUSTING FOR WEAR



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PIPE LINES coated with Reilly Enamel are dependably and lastingly protected against the attacks of corrosive agencies of all types. When properly applied Reilly Enamel forms a coating which completely seals the steel against the agencies that seek to destroy it; a coating hard and tough enough to resist abrasion and soil stress, and so regulated in its properties that it will withstand temperatures as low as minus 20° F. without cracking or checking and as high as 160° F. without flow or sag.

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Directors on tour

Ten directors of Standard Oil Company (Indiana) left from Municipal Airport in New York City recently in 4 private airplanes on a trip of inspection to the offices and laboratories of the producing and pipe line subsidiaries at Tulsa, Oklahoma, and to the oil fields in North and West Texas and New Mexico.

In the party were Robert E. Wilson, chairman of the board, A. W. Peake, president, Max G. Paulus, vice president manufacturing, and Harry F. Glair, general manager manufacturing, R. F. McConnell, vice president sales, and H. E. Hanson, general manager sales, Bruce K. Brown, vice president development, Buell F. Jones, vice president and general counsel, L. C. Welch, general manager lubricating and sales technical service, and F. O. Prior, vice president production and pipe lines. E. F. Bullard, president of Stanolind Oil and Gas Company, was also in the party returning to his headquarters at Tulsa.

Part of the group will return by way of Memphis, Tennessee, for a meeting with officials of Pan American Petroleum Corporation, a marketing subsidiary that operates in Tennessee, Mississippi, Alabama, Louisiana, and Arkansas.

AWS meeting

The 1946 annual meeting of the American Welding Society will be held in New York on October 24, 1946, adjourned immediately without transaction of business, and will reassemble in Atlantic City on November 17 to 22. The reassembled annual meeting will be held in conjunction with the National Metal Congress and Exposition to be held in Atlantic City during the same week. This will be the first 5-day annual meeting held by the Society since 1941. The National Program Committee has already begun to plan the program, which will include the usual social activities, as well as technical sessions.

Joins Ransome Machinery

P. J. Patton, Jr. was recently appointed regional manager by the industrial division, Ransome Machinery Company, Dunellen, New Jersey, a subsidiary of Worthington Pump and Machinery Corporation, with offices at 400 West Madison Street, Chicago, Illinois. He is in charge of sales in the middlewestern area, including such industrial centers as Chicago, Detroit, Cleveland, and St. Louis, and will also assist in solving work and welding problems for Ransome distributors and their customers.

P. J. Patton, Jr.

Patton has a rich background of experience in the welding and engineering fields. Before becoming associated with Ransome, he was eastern area manager of the welding equipment division of A. O. Smith Corporation, Milwaukee, Wisconsin. His previous connection was with the engineering firm of Arthur G. McKee and Company, Cleveland, Ohio.

Grizzly expands

Increased production of Grizzly brake lining through a triple expansion program is well under way. Synonymous with the announcement of full brake block production in the new Grizzly Manufacturing Company plant at Bell, California, Joe Brown, sales manager, announces two sizeable additions to the Grizzly brake lining plant at Paulding, Ohio.

Just completed at Paulding is a new 15,000 sq. ft. building to be devoted entirely to the manufacture of heavy duty brake blocks of ½-in. thickness and greater. Important new brake block production techniques developed by Grizzly engineers at the Bell, California, plant will also be employed at Paulding, where full production is expected shortly.

In the early stages of construction is a 40,000 sq. ft. building to provide greater facilities for the production of passenger car lining and truck sets in sizes up to 6 in. wide by ⅜ in. thick. The building is expected to be ready for production early in Fall.

Still further important improvements planned for the near future are enlarged experimental laboratories and general office facilities.

Export representative

The Houston Oil Field Material Company, Inc., announces the appointment of E. F. Gahan, 500 Fifth Avenue, New York 18, New York, as their export representative.

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Fitting all kinds of pumps and conditions. Each with a rugged body of steel, stainless steel or brass, and durable rubber and duck rings, to give long wear and reduce your well pumping costs.

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C. D. BERRY, Tulsa, Okla.
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WANTED: Sales Engineer by oilfield engine distributor. Engineering graduate with thorough knowledge of East Texas oil field. Address Box No. 44, c/o *The Petroleum Engineer*, P. O. Box 1589, Dallas, Texas.

OFFICERS OF LOS ANGELES NOMADS, 1946. Top row, left to right: T. G. Martin, assistant treasurer; Roland E. Smith, regent; William McGraw, treasurer; Ted Sutter, regent, and Earl M. Daniels, secretary. Bottom row: Wallace A. Sawdon, sergeant-at-arms; James V. Robinson, vice president; Wilbur F. Bettis, president, and Dan Duncan, deputy sergeant-at-arms.

Sales representative

A. G. Bussman, vice president in charge of sales, Wickwire Spencer Steel, announces the appointment of Harry Bottomley as sales representative in the southern Pennsylvania and Virginia territory. He replaces H. C. Stults, resigned.

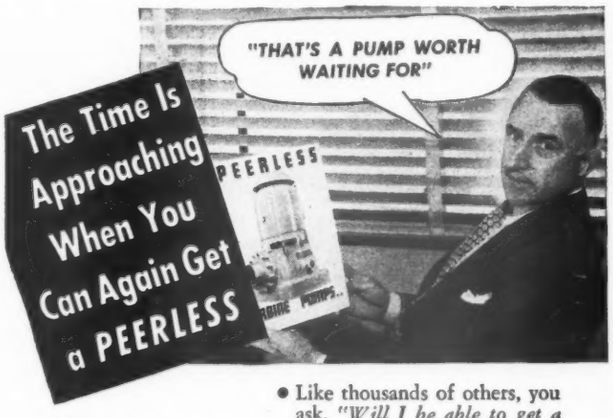
Service conferences

Two caravans left Detroit Diesel Engine Division, General Motors Corporation, on March 1 to conduct conferences on service and maintenance in all parts of the country. After a joint stop at the Western Machinery Company, General Motors distributors in St. Louis, Missouri, the two groups separated, one going to the West Coast and one traveling through the South and East, visiting distributors of GM Series 71 Diesel industrial and marine engines. Their itinerary will cover a total of more than 12,000 miles.

The purpose of the conferences is to emphasize, through prepared charts, films, slides, and work on a live engine, correct methods of maintenance and repair. Both groups are conducting one conference each week in a strategically located city, which will be attended by representatives from several General Motors distributors in a radius of 50 to 300 miles. On this tour, special emphasis will be given to servicing the GM Diesel "uniflow" scavenging blower, GM unit injectors and to engine "tuneup." Sixty per cent of the training time will be actual shop work. The engine and other paraphernalia necessary will be transported from place to place by truck. Conferences will be held with GM Diesel distributors from Missouri, Mississippi, Alabama, Georgia, Louisiana, North Carolina, Maryland, Virginia, Kentucky, Ohio, Pennsylvania, Maine, Massachusetts, New York, Texas, Oklahoma, Montana, Oregon, Washington, California and British Columbia.

This is the first postwar tour of General Motors diesel service instructors, but it is planned to continue such training indefinitely, utilizing special diesel-powered transports as soon as such units are available.

The Service Conference courses are under the supervision of V. C. Genn, general sales manager; A. F. Brecht, service manager, and Neil W. McLeod, assistant service manager of Detroit Diesel Engine Division. The material was prepared by Ralph Braik, service promotion manager, T. L. Guarniere and J. B. Harrison. Detroit men participating in the tours include Braik, Guarniere, Al Hermanny, G. H. Hilley, G. W. McDermott, and V. Shields.



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Deep Well Turbine Pumps
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Oil or Water Lubricated
Capacities: 15 to 30,000 g.p.m.

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For General Service
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Capacities: 2 to 70,000 g.p.m.

Also Jet and Water King Domestic Water Systems

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Food Machinery Corp.

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EASY OPERATION
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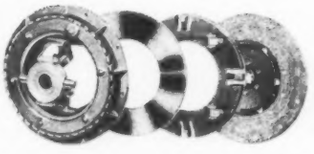

* The pressure plates in ROCKFORD Over-Center CLUTCHES have large area, accurately flat-ground surfaces for maximum contact with the facing material. Special alloy iron is used to withstand shock and heat strains. Provision is made for multiple driving, from the back plate. Have hardened steel bearing inserts, where the roller cams operate. Include these ROCKFORD advantages in your designs.

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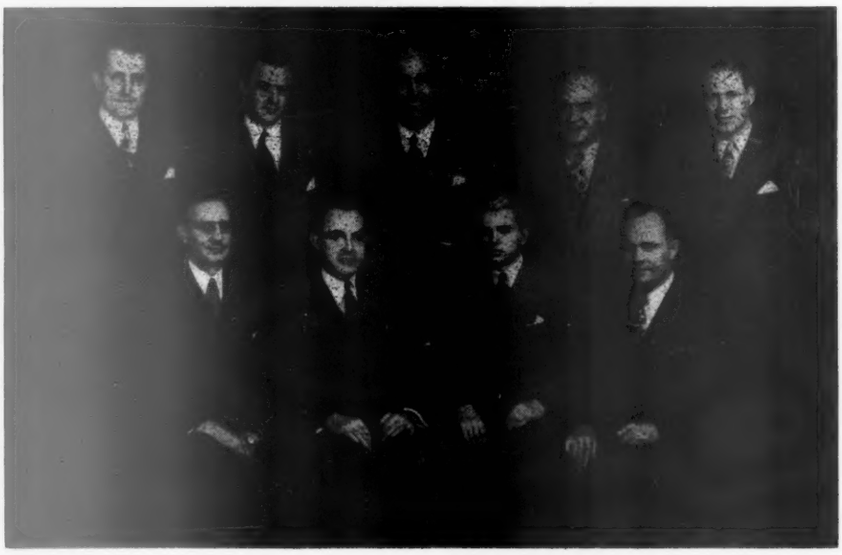
It shows typical installations of ROCKFORD CLUTCHES and POWER TAKE-OFFS Contains diagrams of unique applications. Furnishes capacity tables, dimensions and complete specifications. Every production engineer will find help in this handy bulletin, when planning postwar products.

ROCKFORD CLUTCH DIVISION BORG-WARNER
1303 Eighteenth Avenue, Rockford, Illinois, U. S. A.

ROCKFORD CLUTCHES



OFFICERS FOR 1946 NEW YORK CHAPTER OF NOMADS. Seated, left to right: Val R. Wittich, regent; John H. Baird, president; David J. Muldoon, treasurer; William J. Campbell, regent. Standing, left to right: James W. Reed, secretary; George W. Knight, assistant sergeant-at-arms; Ben A. Hilliard, sergeant-at-arms; Edmund F. Gahan, assistant treasurer; Kenneth J. Langley, assistant secretary. Ralston M. Dinges, vice president, is not in the picture.

Open branches

Stewart and Stevenson Services, Houston, Texas, announce the opening of branch sales and engineering offices at 4801 Lemmon Avenue, Dallas, and 19 East Highway, McAllen, Texas. According to Joe Manning, general manager of the company, the Dallas branch will be under the direction of Charles L. Ward; the McAllen branch will be managed by Richard N. Conolly. Ward stated that the Dallas branch would serve central and north Texas industries with all types of General Motors Diesel and Continental Red Seal gas, gasoline, and butane power plants fabricated by the Houston plant of the company. According to Conolly, the McAllen branch will serve southwest Texas, including the Rio Grande Valley.

An outgrowth of C. Jim Stewart and Stevenson, which started in Houston in 1903, Stewart and Stevenson Services has grown since its formation in 1938 into one of the nation's largest distributors and fabricators of diesel and gas engine equipment. The company offers a complete fabricating service, which includes the designing, engineering, building and installing of power equipment for the oil production industry.

Export distributor

Regan Forge and Engineering Company has recently announced the appointment of the Hunt Export Company as export distributors of its products.

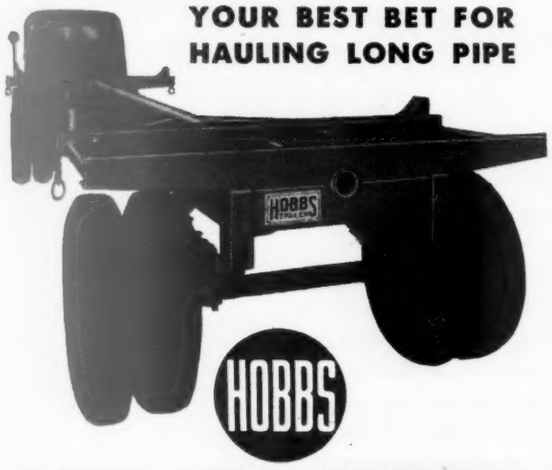
Formed in April, 1945, the Hunt Export Company represents the Hunt Tool Company and a number of other manufacturers of oil industry equipment in countries outside the United States.

The Hunt Export Company maintains offices at 19 Rector Street, New York City; 1945 St. Bernard, Houston, Texas, and Avda. Pte. R. Saenz Pena 832, Buenos Aires, Argentina.

Falcon sold

The Republic Supply Company of California announces the sale of Falcon Products, Inc., effective April 1, to A. R. Loud and H. F. Schlittler, vice president of the company. Loud is the owner of H. W. Loud Machine Works of Pomona, California, and will become president of Falcon Products, Inc., which will continue under the management of H. F. Schlittler as vice president and general manager.

Headquarters of the company will be removed from Los Angeles to 969 East Second Street, Pomona, California, as soon as additional office and warehouse facilities can be provided.



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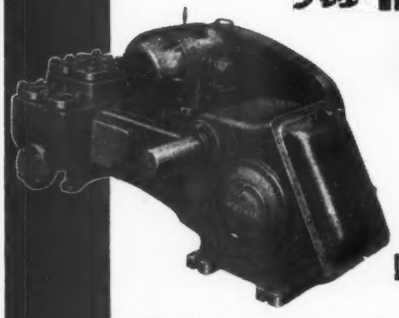

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Joins Votator staff

John E. Slaughter, Jr., vice president of The Girdler Corporation, Louisville, Kentucky, in charge of the firm's Votator Division, has announced the appointment of Allen McKee Bond, Jr. to Votator's technical staff. He will have an important part in Votator's comprehensive research projects and greatly enlarged engineering service program.

Allen Bond, Jr.

Formerly director of research of the Brown and Williamson Tobacco Corporation, Bond served 3 years in the Navy's air arm before joining The Girdler Corporation's Votator Division on January 1, 1946. He attended Louisville Male High School and Phillips Andover Academy, and received his B. S. degree in chemical engineering at Purdue. He is a member of the American Chemical Society and Phi Delta Theta.

Wyoming structure names

Through its nomenclature committee, the Wyoming Geological Association has prepared a list of structure names of Wyoming. This list is as complete as it can be made, and its chief purpose is to eliminate duplications in naming future prospects.

The list shows names alphabetically; the county, and township and range are also given. A serious attempt has been made to show which structural names are synonymous. Multilithed copies may be procured from the Secretary-treasurer, Wyoming Geological Association, P. O. Box 545, Casper, Wyoming, at fifty cents ($0.50) a copy.

Heads Texas Manufacturers

C. K. Stillwagon, president of the Well Equipment Manufacturing Corporation, Houston, Texas, was named president of the Texas Manufacturers Association at a recent election of officers.

The Texas Manufacturers Association plans a greatly expanded program for 1946, hoping to increase the present active membership from 811 to 2500. Ed. C. Burris, former executive vice president and manager of the Shreveport Chamber of Commerce, has accepted the position of executive vice president and manager of the association. He will work with President Stillwagon on the new program.

C. K. Stillwagon

Stillwagon, well known to the oil trade in the United States, has been associated with the oil industry since 1915, being familiar with every phase of the business. He formed his own company, the Well Equipment Manufacturing Corporation, in 1934, and has been president and general manager since its organization. The company is a manufacturer and distributor of oil tools and industrial equipment throughout the world.

Stillwagon recently published a popular book, "Rope Chokers," of human interest stories, anecdotes, historical fragments and pictures, taken from his experiences in the oil fields.

First truck from new plant

Kenworth Motor Truck Corporation has swung into production in its new Seattle plant on Marginal Way, with the first truck rolling off the production line just 9 days after the Seattle truck division completed moving into the new plant, Paul Pigott, president, reveals.

Truck production was halted in the old Kenworth plant on March 1, at which time the truck production department began its move into the new plant. By March 4, this department was completely installed in the new plant and 9 days later, the first truck, a custom-built, heavy duty model 523, was completed.

The factory, purchased by Kenworth last fall for more than half a million dollars, occupies more than 4 of the 15 acres of plant property, which extends from Marginal Way through to the Duwamish Waterway. Utilized as Boeing Plant 3 during the war, the building was formerly the Fisher Body Plant. The factory is a well-constructed, modern, one-story building, which makes greatly increased and improved space available for the manufacture of Kenworth trucks and buses. The six 60-ft. unobstructed bays of the building are being utilized as progressive production lines extending the entire length of the building—460 ft.

Remodeling of the new plant is being rapidly completed and a new office building now under construction in front of the new plant is expected to be completed in June.

Named industrial manager

O. J. Richardson has been appointed industrial manager of the Brown Instrument Company division of Minneapolis-Honeywell Regulator Company at Detroit, Michigan.

Richardson has been with the Brown Instrument Company for the last 10 years, having served as sales engineer and in other capacities at the Philadelphia company's Cincinnati, Buffalo, and Pittsburgh branches.

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in sizes from 2" to and including 4"

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New firm

D. O. Jonnson

Leo W. Fagg

After many years of intimate association in the field engineering department of the S. M. Jones Company, specializing in well studies and engineering problems related to the operation and lifting cost, Douglas O. Johnson and Leo M. Fagg have organized the Johnson-Fagg Engineering Company with offices at 313 Thompson Building, Tulsa, Oklahoma. The firm will devote its services to dynamometer well studies and engineering problems related to the operation of pumping wells.

During the last 10 years, Johnson and Fagg have taken an active part in the growth, development, and application of dynamometer well studies. Johnson joined the S. M. Jones Company in 1935 as manager of the field engineering department. Fagg joined the Jones organization in 1937; has been in charge of field work for the company in many areas of the Mid-Continent and Gulf Coast fields. He succeeded Johnson as department manager when the latter joined the mechanical department of Gulf Oil Corporation in 1943.

Elected director

Hydraulic Products Company of Chicago, Illinois, manufacturers of hydraulic industrial valves, have announced the election of Ben F. Kelley, Tulsa manufacturer and inventor, as a director of their company. Simultaneously it was revealed that the Ben F. Kelley Company has been appointed distributor in the Mid-Continent area.

E. H. Lillybeck, Hydraulic Products president, stated the company will shortly make an important announcement regarding a new line of hydraulically operated oil field equipment. During the war, the company produced special railway equipment parts and important military equipment.

Engineering symposium

A symposium for design engineers on the "Engineering Properties of Gray Cast Iron" will highlight the gray iron technical sessions programmed for the 50th anniversary convention of the American Foundrymen's Association in Cleveland's Public Auditorium May 6 to 10, according to T. E. Eagan, AFA gray iron division chairman.

Scheduled for Wednesday, May 8, with a morning session at 10 o'clock and an afternoon meeting at 2 o'clock, the symposium, open to all users of gray iron castings, will present "in compact, sifted-down form information on the engineering important properties of gray iron in the language of the design engineer and from his viewpoint," Eagan, who is chief metallurgist, Cooper-Bessemer Corporation, Grove City, Pennsylvania, said.

At the morning session William E. Mahin, chairman, metals and minerals division, Armour Research Foundation, Illinois Institute of Technology, Chicago, will discuss briefly the chemistry and the physical and mechanical properties of plain and alloyed irons, touch upon existing specifications and emphasize the importance of improved liaison between design engineers and foundry-

men. In the open discussion period to follow nationally known metallurgists and engineers will join him to form an information panel.

The afternoon session will be devoted to thorough discussion of specific gray iron properties and their more interesting phases with presentation of papers covering such subjects as wear resistance, ductility and elasticity of gray irons, the effect of section size on tensile properties and the relation between tensile tests and actual rupture stresses in castings. Papers to be presented are those of Richard A. Flinn Jr. and Henry J. Chapin of American Brake Shoe Company, Mahwah, New Jersey; C. H. Lorig and T. E. Barlow of Battelle Memorial Institute, Columbus; Henry C. Winte, Worthington Pump and Machinery Corporation, Buffalo, and F. G. Sefing of International Nickel Company, Inc., New York City.

Pointing out that gray iron can no longer be considered in the light of previous knowledge of its physical characteristics, Eagan, in his announcement of the symposium, said:

"Years of research and improvement have demonstrated that gray iron is a very unique material capable of wide application and of use in the solution of many difficult engineering problems; but because its composition is complex, the excellent engineering properties of gray iron have become hidden in a mass of chemical and metallurgical data of little interest or practical value to designing engineers. This symposium, however, will present engineering properties in the form in which engineers want them and mechanical and tool engineers are especially invited to attend."

Director public relations

H. R. Straight, president of Cities Service Oil Company, has announced the appointment of M. L. Margenau as director of public relations. Margenau succeeds the late R. J. Daugherty.

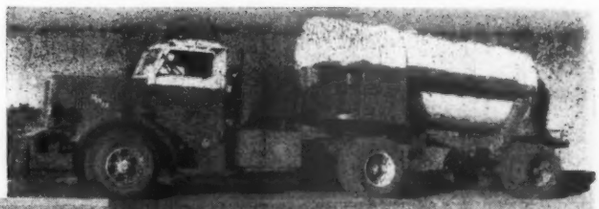
M. L. Margenau

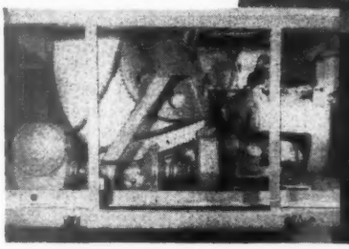
A long-time employe of Cities Service, Margenau joins the Public Relations Department with a wide variety of experience in the public utility and oil industries. His work in these two fields includes public and employe relations, house magazine editing, advertising and publicity, valuation of utility, pipe line and oil industry properties, rate studies, engineering and managerial positions.

After graduating from the University of Wisconsin with a bachelor of science degree in electrical engineering, Margenau became affiliated with the Cities Service Company in 1917 as a cadet. Shortly thereafter, he was transferred to Empire District Electric Company, a Cities Service utility with headquarters at Joplin, Missouri. During his 15 years with this company, he worked up from a construction job to supervisor of budgets, head of public and employer relations, district manager, and to assistant general manager of the company.

Then followed a year as special assistant to the manager of Toledo Edison Company, another Cities Service utility company, after which Margenau joined the staff of Petroleum Advisers, Inc., the technical and coordinating unit of Cities Service Company's petroleum and natural gas pipe line subsidiaries.

OIL WELL CEMENTING





Another Service Responsibility for WISCONSIN Air-Cooled ENGINES

Cementing oil wells, as every operator knows, requires the most dependable equipment possible to secure. The deeper the oil sands, the greater the quantities of cement required . . . mixed rapidly and pumped into the well with equal speed and constancy. Pumping, once started, must continue without interruption due to the higher temperatures at lower depths.

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Oil field distributors for Wisconsin Engines and all types of utility units.

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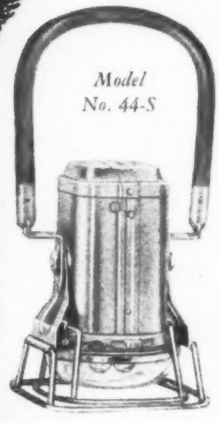

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If this Housing ever Breaks or Distorts we will replace it Free
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● You get a powerful I-beam handle so comfortable you can give it all the pull you've got — *barehanded.* Precision-cut alloy jaws take-hold and let-go instantly — full-floating hook-jaw has handy pipe scale, heel-jaw is replaceable. Adjusting nut won't bind, spins freely in all sizes. And the guaranteed housing means long expense-free service — most for your money. Buy RIDGID at your Supply House.

RIDGID *End Wrench for pipe in coils, against flat surfaces.*

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Pacific Personalities

DICK SNEDDON

In bygone days, we used to pull into Santa Paula occasionally for a visit with George Gosline, then Union's Ventura district superintendent. George was a mechanical whiz and we invariably found him tearing down a well puller, revamping a bulldozer, or reshaping some other heavy piece of equipment to the peculiar needs of his extremely rugged district. Hovering near as often as he could make it was a young lad who, like Saroyan's Ulysses, crowded in close and watched every move in speechless fascination. This was George's son, Jim, now manager of southern district operations for Standard of Cal, and something of a mechanical whiz himself. Jim not only acquired his dad's interest and understanding of mechanical functions and machines, but he supplemented it later with a brilliant academic record, and today is one of California's outstanding production engineers. It may not be so well known, but Jim is also something of an expert on dogs, particularly a specimen named Tony, who thinks as much of his master as if he were a bone. Tony is a bird dog, but doesn't care for them until they are cooked, and is reputed to be a great scrapper. They say that when he was just a little pup, he frequently licked his paw.

●

Speaking of other days, a group of construction men were laying some gas lines on Torrey Hill in the Santa Paula district in 1920. They were having a housing shortage up there at the time, so they put up an army tent to protect themselves from the elements. Roaming the vicinity were some goats, harmless but hungry. The one thing these goats seemed to pine for was a good meal of pure wool, rich in the vitamins that goats crave. In any case, no sooner had the men walked out of the tent the morning after its erection than the goats walked in, and forthwith launched such an orgy of wool gathering as hadn't been seen since the invention of sheep. Without even stopping for a drink, the animals ate up two pairs of woolen blankets, and then for a chaser ate two suits of clothes. They were still looking around for dessert when the men returned and chased them almost to the San Joaquin Valley. It is probably fiction, but we have been told that the following spring, several kids were seen running around the area, garbed in woolen sweaters.

●

Back from the wars and comfortably ensconsed in the land department of Union Oil Company is Howard Said, who is without question California's outstanding barefoot golfer. Howard only keeps his shoes on until he gets away from the clubhouse, but as soon as he gets into the mountains, which is usually soon, he sheds his brogans and thereafter scrambles from cliff to cliff with feet fully exposed. This assures him of having at least one extremity cool to carry on his vicarious mission. Incidentally, for those who are technically minded, we might mention that it makes no difference to his golf, which perhaps explains why he so stoutly endorses freedom of speech.

●

Another golfer but recently released from the army is Edwin Ross, son of Hans Ross of Baash-Ross Tool Company. Ed is a Stanford graduate in engineering, and worked for the tool company before the army crooked its finger at him in such a pleading way that he couldn't refuse. He will in future promote sales in the Mid-Continent fields, and will continue his golf practice on the slightest provocation. We understand that he is getting along so well, his two boys are now allowed to watch him play. Associated closely with Ed, incidentally, in army ordnance, and freed at the same time, was Bill Wilson, son of Web Wilson, who has been named assistant manager of the Web Wilson Tool Company. Bill is also a Stanford graduate in engineering, is moderately addicted to divot lofting, but prefers boating because it is easier on the feet. Despite what the war has done to the economic system, he is convinced that true salesmanship is still the simple art of selling goods that won't come back to people who will.

●

Nate Mull, superintendent of The Texas Company's gas division in California, has at last given up his handball struggle. For many years Nate tried hard to achieve distinction in the handball world, but all he ever acquired was a hand like a meatball. His digits are now perfectly normal, however, and he applies himself to less strenuous pursuits. He is still wondering why so many natural gas plants are presided over by unnatural operators, and, now that even our memories are taxed, he thinks it is a remarkable coincidence that Texas, the name of the biggest oil state in the country, by a simple transposition becomes "taxes."

●

That well known explorer of field and stream, Don Weaver, field manager of Wilshire Oil Company, is perhaps the petroleum indus-

try's greatest authority on hunting dogs. His understanding of the two most popular types—retrievers and pointers—is nothing short of staggering. He reveals, for instance, the astonishing fact that a pointer can be so well bred, he will regard pointing as the worst of bad manners, and refuse to do it. He suggests that the hunter be not disturbed by this, but that he simply bend one knee, tilt his head back, and temporarily do his own pointing. This will so humiliate the dog that he is not likely ever again to pull such a brodie. The retriever, we are informed by our caninologist, is a very friendly animal, always on the job, and constantly bringing home to his master, little things of which he little wots, if we may use an old English expression that we have often wished we understood.

•

Some years ago, Frank Hill, honorary president of the Petroleum Production Pioneers, and at that time, director of production for Union Oil Company, was required rather suddenly to make a report on current operations in the San Joaquin Valley. His regular secretary was not available, so he called in a girl from the reception room to take his dictation. This girl was quite unfamiliar with geological and general field terms, but she made a brave effort. Speaking of a Belridge well, which hadn't turned out so well, Mr. Hill said, "Perhaps the greatest disappointment Union Oil Company has experienced in the past few months, was the encroachment of edge water into the principal member of the Temblor." How this appeared in the young lady's transcribed notes was, "Perhaps the greatest disappointment that Union Oil Company has experienced in the past few months, was the encroachment of water into the principal members on the tenth floor."

•

Bill McLaine is back at the General Petroleum Corporation headquarters in Los Angeles as busy as ever and looking even younger than when he dropped out momentarily. Bill is one of the directors in the Petroleum Production Pioneers' historical committee, which is making a really serious effort under the leadership of Ted Sutter to run down the consequential event and episode in the early stages of California petroleum development. Bill also is one of the most able exponents of color photography we have ever seen. His prints make many of the professionals look a bit amateurish, and he has a collection of his own work that is worthy of a salon all to itself. It is interesting to note that Starke Fox, not long released by the Navy, and an attache of the Oil Producers Agency, has been retained to start the compilation of historical and biographical material for the Pioneers. That is a very appropriate choice, for Starke is himself a scion of an old California oil family that has grown up with the industry, and has made notable contribution to the petrolic record. His father was the originator of the *California Oil World*, and was active on many industry committees, both local and national, for many years.

•

Caught a glimpse of Stew Meece, erstwhile Sperry Sun engineer, at the Nomad's meeting the other night, but didn't have a chance to find out where he has been adventuring with the Navy for the last 2 years; however, he appears to be on the loose again and we shall have an opportunity to find out his plans a little later. Meantime, he doesn't appear to have suffered from the experience and looks as if he might be rather pleased about resuming his place on the industrial front. Also, we dashed around a corner on Sixth Street the other day and almost collided with L. P. St Clair, looking hale and hearty and smiling pleasantly despite the near accident.

•

Charlie Brewster, Standard of Cal's northern division drilling superintendent, was in Colombia fairly recently on Richmond Petroleum Company business, and was invited to a swanky party at which were assembled all the leading bankers, merchants, and consequential oil men in that particular part of South America. Among the guests were a few Californians, especially L. R. "Rusty" Miller, of Richmond Petroleum, well known to the folks down there in Colombia. Being a man who has never been known to miss an opportunity for some fun, Rusty rose and in the manner of Senator Claghorn introduced Charlie Brewster as one of the really great men of the oil industry, one, indeed, who had started his career as a tool dresser for Colonel Drake. In acknowledging the deafening applause that followed this pronouncement, Charlie modestly admitted that there was a modicum of truth in the statement, but denied that he had started his career with Colonel Drake, and pointed out very soberly that when he was associated with the Colonel, the latter was just a boy, while Charlie was already pretty well along in years and a man of long experience in the oil industry. The affair created a junior sensation at the meeting, and has even had an interesting aftermath, to wit: Charlie Brewster has sent in Rusty's application for membership in the Petroleum Production Pioneers, along with payment of dues and an insinuation that Rusty is so old and feeble he can't sign a check any more.

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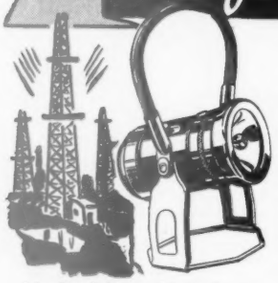

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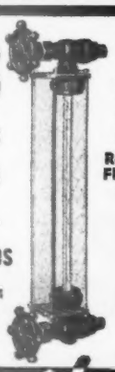

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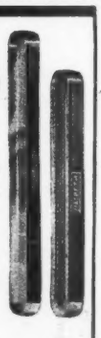

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Book Reviews

● **Oil-bearing Sands in Southwestern Pennsylvania,** *by L. S. Matteson and D. A. Busch. Published by Department of Internal Affairs.*

This report and the maps accompanying it represent a war time emergency study and are in most respects a preliminary treatment of the oil fields of southwestern Pennsylvania. The original purpose of this study was to aid in selecting area for possible secondary recovery operations, such as water-flooding, air, or natural gas repressuring. It is also useful in extending the limits of the old pools and in the discovery of new pools.

● **Practical Design Handbook for Engineers,** *by Dr. Alois Cibulka. Published by Clarke & Courts, Houston, Texas. Pages, 400. Price, $6.00.*

This book was written for those engineers who like to do the most in the shortest possible time. It is actually ten engineering books in one with direct answers to many problems. All charts are large enough for accurate reading and practical examples make their use clear. The author, Dr. Alois Cibulka, is a doctor of engineering.

● **Calculus for Practical Engineers,** *by Dr. Alois Cibulka. Published by The Steck Company, Ausin, Texas. Pages, 100. Price, $3.00.*

Calculus, made simple, is the purpose of this book, by Dr. Alois Cibulka, owner of "RST" Engineering Company of America. Ths new book has only 100 pages but it contains very valuable tables, mathematical formulas, and more practical examples than other books of many times its size. Every engineer should have a working knowledge of Calculus and this book shows a simple, quick engineering way. It can be purchased from Clarke & Courts, Houston, Texas.

● **Pennsylvania's Mineral Heritage.** *Published by the Commonwealth of Pennsylvania, Department of Internal Affairs, William S. Livengood, Jr., Secretary. Pages, 248.*

Much research work and cooperative effort on the part of the Department of Internal Affairs and the School of Mineral Industries of the Pennsylvania State College resulted in the publication of this report. It is a document for the use of those interested in the best use of Pennsylvania's mineral deposits and development of her manufactures. It is intended to be useful in the encouragement of post-war employment and as an educational instrument. Divided into three parts, Statisics of the Mineral Industries, Mineral Resources, and Technology and Trends in the Mineral Industries, this book is a thorough report on the mineral resources of Pennsylvania.

Copies may be purchased from the Division of Documents, Department of Property and Supplies, Harrisburg, Pennsylvania.

● **Introduction to the Study of Natural Gas—Metering and Handling Natural Gas.** *Issued by The University of Texas and State Board for Vocational Education. Pages, 27.*

This is the first of a series of four manuals being prepared under the general title of Handling and Metering Natural Gas. It is designed specifically for group instruction of non-technical field personnel of the petroleum production industry. The manual is being developed at the request of many men in the oil industry who recognize the growing importance of gas in the production of petroleum and petroleum products.

● **Review of Fatal Injuries in the Petroleum Industry for 1944.** *Published by the Department of Accident Prevention, American Petroleum Institute. Pages, 21.*

The fourteenth annual review of fatal injuries as reported to the American Petroleum Institute for 1944 contains tables showing the various causes of fatal injuries in all departments of the oil industry. The causes of the 1944 fatalities are compared with the accident causes of 1943. Several examples of fatal accidents are described in each of the following departments: Refining, Marketing, Drilling, Production, Natural Gasoline, Pipe Line, and Marine.

Named representative

Northern Equipment Company, Erie, Pennsylvania, announces the appointment of The Kissick Company, 1524 Chestnut Street, Philadelphia, Pennsylvania, as sales and service representatives for Copes feed water regulators, pump governors, desuperheaters, and allied equipment. The territory served includes southern New Jersey, southeastern Pennsylvania, eastern Maryland, and Delaware.

Josph Kissick, Jr., has been associated with the Copes organization for more than 25 years and has in recent years headed his own organization in New York. William L. Corbin is in direct charge of the new office. Before the war, during which he was an engineering officer in the Navy with the rank of lieutenant-commander, he had been for some years with the Copes representatives in New England.

Failing officials take to air

Executives of the Geo. E. Failing Supply Company, of Enid, Oklahoma, and Houston, Texas, manufacturers of portable oil field drilling and exploration equipment, will "take to the air" in a new five-place Beechcraft plane, delivery of which has just been accepted by the company.

The plane has been christened the "Core Driller".

The Failing company also has on order another five-passenger Beechcraft delivery of which is anticipated in September. In addition the company also expects to purchase a smaller Cessna plane for shorter trips.

Harold Holden, former Army Air Corps flier, will be the pilot for the Failing planes and a special hangar is under construction for them at the Enid airport.

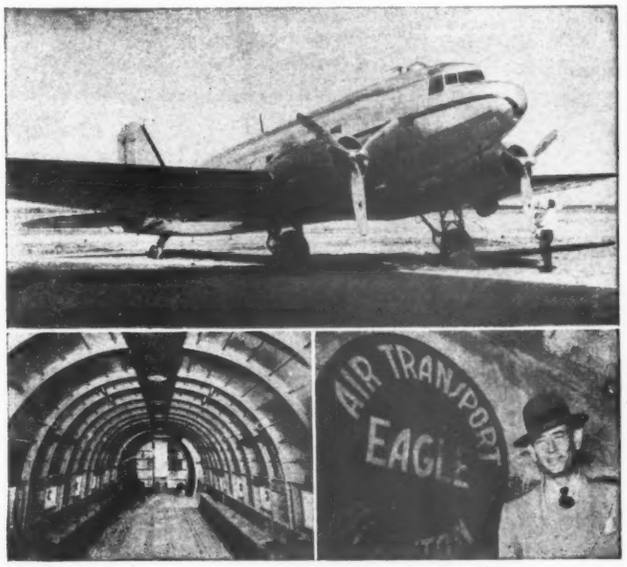
Oil industry gets air service

Eagle Air Transport, with headquarters at Municipal Airport, Houston, Texas, began operations March 1, as a non-scheduled air service especially developed for the oil industry where speed is a prime factor in the moving of men and equipment to emergency, or unusually important, jobs. This unique service is the answer to a long-time problem among oil tool manufacturers who operate special field services such as fishing tool and other trouble jobs.

The initial plane especially equipped for this service is a C-47 purchased from the government by John H. Eagle, old-time Houston pilot and recently discharged as an Army Air Corps Major after more than 3 years' service. Eagle is owner and manager of Eagle Air Transport. He flew this same class of airplane more than 2500 hr. for the army and has more than 8000 hr. as a pilot to his credit during 18 years in aviation. His experience includes 2 years with Civil Aeronautics Administration and 2 years flying for the airlines. He is one of the best known commercial pilots in the business.

The C-47 ship is licensed to carry 27 men, including the crew, or 6000 lb. of cargo. It is especially arranged for a combination of oil field equipment and the necessary crew to operate the equipment, or can be immediately converted to haul all passengers or all cargo. A cargo floor, as used for army hauling, is used, yet comfortable airline seats have been installed. Special lockdown arrangement for tools is used. Length of the ship allows for transporting 30-ft. joints of pipe.

The company offers overnight service from Houston to Los Angeles, with stops at Odessa and Tucson. A special service is also available to Mexico, Central and South America.



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